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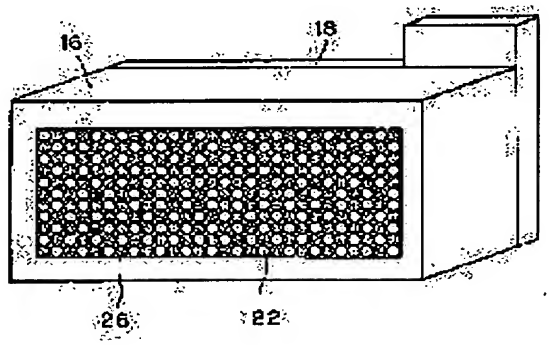
(54) FIBER CELL AND ITS MANUFACTURING METHOD

(57)Abstract:
PROBLEM TO BE SOLVED: To provide a cell significantly improved in both charging speed and discharging speed.
SOLUTION: The cell is composed by bundling or laminating as fabrics fibrous materials having electron conductivity applied with a cell active material on surfaces. For example, by contacting and fixing the cell active material on the fibrous materials having electron conductivity and bundling the fiber with the active material, a cell capable of high output is formed.



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CLAIMS

[Claim(s)]
[Claim 1] Whether what carried out the coat of the front face of fibrous material with electronic conduction nature with positive active material is put in order by the shape of every 1 or a bundle Or the positive electrode used as textiles, Whether what carried out the coat of the front face of fibrous material with electronic conduction nature with the negative-electrode active material is put in order by the shape of every 1 or a bundle or the negative electrode used as textiles A laminating is carried out on both sides of the separator which does not have electronic conduction nature and has ion conductivity between a positive electrode and a negative electrode. The fiber cell characterized by the thing of the fibrous material of the fibrous material laid as a positive electrode which the positive-electrode charge collector was attached so that an end might touch at least, and was laid as a negative electrode which the negative-electrode charge collector was attached so that an end might touch at least, the cell cel was filled up with the electrolytic solution, and was constituted.
[Claim 2] Whether what carried out the coat of the front face of fibrous material with electronic conduction nature with positive active material, and covered the outside with the porosity matter which does not have electronic conduction nature and has ion conductivity further is put in order by the shape of every 1 or a bundle Or the positive electrode used as textiles, Or the laminating of the negative electrode used as textiles is carried out. or [putting in order what carried out the coat of the front face of fibrous material with electronic conduction nature with the negative-electrode active material, and covered the outside with the porosity matter which does not have electronic conduction nature and has ion conductivity further by the shape of every 1 or a bundle] -- The fiber cell characterized by the thing of the fibrous material of the fibrous material laid as a positive electrode which the positive-electrode charge collector was attached so that an end might touch at least, and was laid as a negative electrode which the negative-electrode charge collector was attached so that an end might touch at least, the cell cel was filled up with the electrolytic solution, and was constituted.
[Claim 3] It considers as the warp which carries out the coat of the front face of fibrous material with electronic conduction nature with positive active material, makes what covered the outside with the porosity matter which does not have electronic conduction nature and has ion conductivity further every 1 or a bundle, and is used for a positive electrode. As the weft which carries out the coat of the front face of fibrous material with electronic conduction nature with a negative-electrode active material, makes what covered the outside with the porosity matter which does not have electronic conduction nature and has ion conductivity further every 1 or a bundle, and is used for a negative electrode The textiles which used warp and the weft as the positive electrode and the negative electrode respectively are formed, and a laminating is carried out so that these textiles may serve as the same direction in every direction. A positive-electrode charge collector is attached from both sides or one side. the direction of warp of textiles, and abbreviation -- the fibrous material of the warp which is a positive electrode in a vertical field -- so that an end may touch at least the direction of the weft of textiles, and abbreviation -- the fiber cell characterized by the thing of the fibrous material of the weft which is a negative electrode which the negative-electrode charge collector was attached from both sides or one side so that an end might touch at least, the cell cel was filled up with the electrolytic solution, and was constituted in a vertical field.
[Claim 4] The fiber cell according to claim 2 or 3 which is resin which extracted the solvent from the resin which the porosity matter which does not have electronic conduction nature and has ion conductivity dissolved in the solvent using the resin which dissolves in a solvent meltable to water or alcohol in water or alcohol, and was made into porosity.

[Claim 5] The polyether sulfone resin which the resin which dissolved in the solvent meltable in water dissolved in dimethyl sulfo oxide, The polysulfone dissolved in the polystyrene, dimethylformamide, or dimethyl sulfo oxide which dissolved in the acetone, The polyacrylonitrile which dissolved in dimethylformamide, dimethyl sulfo oxide, or ethylene carbonate, The polyvinylidene fluoride dissolved in dimethylformamide, dimethyl sulfo oxide, or a N-methyl-2-pyrrolidone, The polyamide which dissolved in dimethylformamide or a N-methyl-2-pyrrolidone, Or it is polyimide which dissolved in dimethylformamide or a N-methyl-2-pyrrolidone. The cellulose acetate which the resin which dissolved in the solvent meltable to alcohol dissolved in the methylene chloride, or the fiber cell according to claim 4 which is the oxide phenylene ether dissolved in the methylene chloride.

[Claim 6] The fiber cell according to claim 2 or 3 whose porosity matter which does not have electronic conduction nature and has ion conductivity is the membrane film or nonwoven fabric of a polyolefine system represented by a solid electrolyte, Teflon (trademark), polyethylene, or polypropylene.

[Claim 7] For ******, the matter with which fibrous material has the electronic conduction nature represented by a carbon fiber or the metal fiber or the organic fiber which carried out metal plating to the front face, an inorganic fiber, and fibrous plastics are also the fiber cell according to claim 1 to 6 it is [cell] rubber.

[Claim 8] A negative-electrode active material with nickel/nickel hydroxide The cell of cadmium, [positive active material] A negative-electrode active material with nickel/nickel hydroxide The cell of a hydrogen storing metal alloy, [positive active material] A negative-electrode active material with nickel/nickel hydroxide The cell of iron/iron hydroxide, [positive active material] A negative-electrode active material with nickel/nickel hydroxide A zincky cell, [positive active material] A negative-electrode active material with a lithium/lithium compound by lead/lead dioxide A carbonaceous cell, [positive active material] [a negative-electrode active material] [a leaden cell and positive active material] A negative-electrode active material by the manganese dioxide The cell of a lithium/lithium compound, [positive active material] A negative-electrode active material with air with air The cell of magnesium, [a positive electrode] [a negative-electrode active material] [the cell of aluminum, and a positive electrode] For positive active material, a negative-electrode active material is a zincky cell and the fiber cell according to claim 1 to 7 whose negative-electrode active material the cell of cadmium or positive active material is [positive active material] a zincky cell in a silver oxide for a negative-electrode active material at a manganese dioxide with a silver oxide.

[Claim 9] The fiber cell according to claim 1 to 8 which filled up one cel with one or more basic units which put positive-electrode fiber and negative-electrode fiber in order, or carried out the laminating as textiles.

[Claim 10] The fiber cell according to claim 9 which compressed the basic unit and was built into the cell cel as a consolidation condition.

[Claim 11] The fiber cell according to claim 10 which bound the basic unit with the band form or string-like object which consists of the insulator or the colliquative or non-colliquative insulator of porous or imperforation, and was made into the consolidation condition.

[Claim 12] They are restoration or the fiber cell according to claim 1 to 11 which carried out the laminating to the same cel about the layered product which consists of fibrous material which carried out the coat of the cell active material with which charge-and-discharge properties differ to the front face.

[Claim 13] The fiber cell according to claim 1 to 11 which filled up or carried out the laminating and constituted many things which attached to the front face of one fibrous material the cell active material with which charge-and-discharge properties differ in the cell cel.

[Claim 14] The fiber cell characterized by separating and carrying out the laminating of the single cel which consists of cells according to claim 1 to 13 by the septum, and considering as high tension.

[Claim 15] The fiber cell according to claim 1 to 14 which only the positive-electrode or negative-electrode side used what carried out the coat of the front face of fibrous material with the cell active material, and filled up the other pole side with the cell active material fabricated a particle, a fine-particles-like cell active material, in the shape of a plate, etc. instead of the fibrous material which carried out the coat of the front face with the cell active material.

[Claim 16] The fibrous material which attached the cell active material to the front face of fibrous material with electronic conduction nature, and carried out the coat of the front face with positive active material A positive electrode, Or it considers as textiles. or [making fibrous material of a positive electrode into every 1 or a bundle, and putting it in order by using the fibrous material which carried out the coat of the front face with the negative-electrode active material as a negative electrode,] -- It covers with the separator which does not have

electronic conduction nature on it and has ion conductivity. Make fibrous material of a negative electrode into every 1 or a bundle, and arrange it in on a separator, or it covers as textiles. On both sides of the separator, carry out the laminating of a positive electrode and the negative electrode, and a positive-electrode charge collector is pushed from one side or both sides from the abbreviation perpendicular direction of fibrous material so that an end may touch, even if there is little fibrous material by the side of a positive electrode. The manufacture approach of the fiber cell characterized by the thing of the fibrous material by the side of a negative electrode for which a negative-electrode charge collector is pushed from one side or both sides from the abbreviation perpendicular direction of fibrous material so that an end may touch at least, a cell cel is filled up with the electrolytic solution, and a cell is completed.

[Claim 17] Attach a cell active material to the front face of fibrous material with electronic conduction nature, and the outside is further covered with the porosity matter which does not have electronic conduction nature and has ion conductivity. The fibrous material which carried out the coat of the front face with positive active material, and was further covered with porous membrane A positive electrode, The fibrous material which carried out the coat of the front face with the negative-electrode active material, and was further covered with porous membrane is used as a negative electrode. Or it covers as textiles. or [making fibrous material of a positive electrode into every 1 or a bundle, and putting it in order] -- it considering as textiles, and fibrous material of a negative electrode being made into every 1 or a bundle, and being arranged in on it, or A positive-electrode charge collector is pushed from one side or both sides from the abbreviation perpendicular direction of fibrous material. a positive electrode and a negative electrode -- alternation -- or -- random -- a laminating -- carrying out -- the fibrous material by the side of a positive electrode -- so that an end may touch at least The manufacture approach of the fiber cell characterized by the thing of the fibrous material by the side of a negative electrode for which a negative-electrode charge collector is pushed from one side or both sides from the abbreviation perpendicular direction of fibrous material so that an end may touch at least, a cell cel is filled up with the electrolytic solution, and a cell is completed.

[Claim 18] Attach a cell active material to the front face of fibrous material with electronic conduction nature, and the outside is further covered with the porosity matter which does not have electronic conduction nature and has ion conductivity. The fibrous material which carried out the coat of the front face with positive active material, and was further covered with porous membrane A positive electrode, The fibrous material which carried out the coat of the front face with the negative-electrode active material, and was further covered with porous membrane is used as a negative electrode, and fibrous material of a positive electrode is made into every 1 or a bundle, it considers as warp, and fibrous material of a negative electrode is made into every 1 or a bundle. As the weft Produce the textiles which used warp and the weft as the positive electrode and the negative electrode respectively, and the laminating of these textiles is carried out so that it may become the same direction in every direction. A positive-electrode charge collector is pushed from both sides or one side. the direction of warp of textiles, and abbreviation -- the fibrous material of the warp which is a positive electrode in a vertical field -- so that an end may touch at least the direction of the weft of textiles, and abbreviation -- the manufacture approach of the fiber cell characterized by the thing of the fibrous material of the weft which is a negative electrode for which a negative-electrode charge collector is pushed from both sides or one side so that an end may touch at least, a cell cel is filled up with the electrolytic solution, and a cell is completed in a vertical field.

[Claim 19] The manufacture approach of a fiber cell according to claim 16, 17, or 18 of attaching a cell active material on the surface of fibrous material using the electrolytic deposition method by electrolysis.

[Claim 20] The manufacture approach of a fiber cell according to claim 19 of making it suspending in an electrolytic bath, and incorporating and carrying out the eutectoid of the cell active material into a plated metal with eutectoid plating by making a cell active material into a particle in the case of the electrolytic deposition by electrolysis.

[Claim 21] The manufacture approach of the fiber cell according to claim 16, 17, or 18 which fixes a cell active material on the surface of fibrous material using resin.

[Claim 22] As resin, it is the manufacture approach of a fiber cell according to claim 21 of polyethylene, polypropylene, and ethylene vinyl acetate copolymer of it being independent, or combining one of thermoplastics or an epoxy resin, polyurethane resin, and the heat-curing mold resin of an unsaturated polyester resin represented by one of reaction hardening mold resin, or phenol resin at least, and using it at least.

[Claim 23] The manufacture approach of the fiber cell according to claim 21 which carries out heating

clearance of the solvent under reduced pressure or ordinary pressure after carrying out the coat of the resin of the polyethylene which dissolved in the heating toluene or the xylene which is resin which dissolved in the solvent as resin, polypropylene, and ethylene vinyl acetate copolymer which dissolved in the solvent to a front face using one of thermoplastics at least.

[Claim 24] The polyether sulfone resin which dissolved in the dimethyl sulfo oxide which is resin which dissolved in the solvent meltable in water as resin, The polysulfone dissolved in the polystyrene, dimethylformamide, or dimethyl sulfo oxide which dissolved in the acetone, The polyacrylonitrile which dissolved in dimethylformamide, dimethyl sulfo oxide, or ethylene carbonate, The polyvinylidene fluoride dissolved in dimethylformamide, dimethyl sulfo oxide, or a N-methyl-2-pyrrolidone, The polyamide which dissolved in dimethylformamide or a N-methyl-2-pyrrolidone, Or the polyimide which dissolved in dimethylformamide or a N-methyl-2-pyrrolidone, Or the cellulose acetate which dissolved in the methylene chloride which is resin which dissolved in the solvent meltable to alcohol, Or the manufacture approach of the fiber cell according to claim 21 which carries out extract clearance of the solvent in water or alcohol after carrying out the coat of the resin which dissolved in the meltable solvent to water or alcohol on a front face using the oxide phenylene ether which dissolved in the methylene chloride.

[Claim 25] In order to give conductivity to resin, it is the manufacture approach of the fiber cell of the whisker of the particle of carbon black, a carbon fiber, a carbon foil, a carbon whisker, and a nickel metal, a nickel foil, and a nickel metal according to claim 21 to 24 which adds one of conductive raw materials to resin at least.

[Claim 26] The manufacture approach of the fiber cell according to claim 25 which is dissolved, mixes resin and is distributed after mixing the resin and the conductive raw material which were dissolved in the solvent to resin as an approach of adding a conductive raw material, distributing it, or mixing a conductive raw material with a solvent and distributing.

[Claim 27] The manufacture approach of a fiber cell according to claim 16, 17, or 18 of attaching a cell active material on the surface of fibrous material by hot dipping.

[Claim 28] The manufacture approach of a fiber cell according to claim 16, 17, or 18 of attaching a cell active material on the surface of fibrous material by sintering.

[Claim 29] The manufacture approach of the fiber cell according to claim 17 or 18 which carries out extract clearance of the solvent in water or alcohol after carrying out the coat of the resin which dissolved in the solvent meltable to water or alcohol to a front face using the resin which dissolved in the solvent meltable to water or alcohol as porosity matter which does not have the electronic conduction nature which covers with a cell active material the fibrous material which carried out the coat of the front face, and has ion conductivity.

[Claim 30] The manufacture approach of a fiber cell according to claim 17, 18, or 29 of exposing the cross section of fibrous material and contacting a charge collector in this cross section by attaching a cell active material to fibrous material, and cutting what covered the outside with the porosity matter further.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to the fiber cell in which the high power which it was sufficient for in the bundle, or carried out the laminating of what attached the cell active material to the front face of fibrous material with electronic conduction nature as textiles, and constituted it is possible, and its manufacture approach.
[0002]
[Description of the Prior Art] The so-called three-dimensions cell which constituted by carrying out a cell active material to fine particles or a particle is indicated by the patent No. 3051401 official report. Moreover, patent application is already made also about the laminated three-dimensions cell (Japanese Patent Application No. 11-309627). Moreover, these people are doing patent application also with the three-dimensions cell which was filled up with the particle-like active material and used as the fixed bed (an application for patent 2000-332281, application for patent 2000-332503). Furthermore, an electric conduction filler is added to active material ingredient powder, and these people are doing patent application also with the cell active material (application for patent 2001-280847) which fabricated in the shape of a particle etc. and was stiffened by resin, and the cell active material (application for patent 2001-280848) which carried out secondary forming of the primary Plastic solid which added the electric conduction filler to active material ingredient powder, and was stiffened by resin to the shape of a plate etc.
[0003]
[Problem(s) to be Solved by the Invention] For example, the thickness of the cell active material of the nickel hydoride battery known from the former or a ferronickel cell is around 1mm, and since the diffusion to which ion and an electron move the inside of an active material is rate-limiting, a high increase in power is difficult. Then, in order to give electronic conduction nature conventionally to nickel hydroxide without electronic conduction nature, addition of cobalt and restoration to porous metal are performed. Moreover, since the thickness of the cell active material of a lithium ion battery is around 100 micrometers and diffusion of a lithium ion is rate-limiting for example, a high increase in power is difficult. In this case, since a lithium ion is very huge as compared with a proton, there is no approach shortening a travel only moves a lithium for a short time.
[0004] Moreover, for example, the thickness of the lead which is the active material of a lead accumulator, and a lead dioxide has the huge sulfate ion of the electrolytic solution which is around 1mm and is also an active material, and migration of sulfate ion is rate-limiting. In this case, although electronic conduction nature does not have the approach making it thin only gathers a reaction rate since a lead dioxide is low, when thickness was forcibly made thin and a high current is passed, a voltage drop happens violently. Furthermore, by the conventional cell, electric conduction material and charge collectors, such as nickel with which the cell active material touches, are welded, and recycle is difficult.
[0005] What has the huge matter which this invention was made in view of above-mentioned many points, and must move in a cell active material in order to react, what has very small electronic conduction nature, and Since high power becomes possible by shortening a travel as much as possible, what attached the thin cell active material layer to the front face of the matter with electronic conduction nature fibrous as migration paths, such as an electron It aims at offering the fiber cell in which the high power which is not in the former is possible, and its manufacture approach by being sufficient in a bundle, or carrying out a laminating as textiles,

and constituting a cell. Moreover, by considering only as the configuration which holds down with a charge collector what put in order fibrous material with the electronic conduction nature which carried out the coat of the cell active material to the front face, or carried out the laminating as textiles, the need for welding like before is lost and it aims at offering the fiber cell which can do recycle easily, and its manufacture approach.
[0006]
[Means for Solving the Problem] In order to attain the above-mentioned object, the fiber cell of this invention Whether what carried out the coat of the front face of fibrous material with electronic conduction nature with positive active material is put in order by the shape of every 1 or a bundle Or the positive electrode used as textiles, Whether what carried out the coat of the front face of fibrous material with electronic conduction nature with the negative-electrode active material is put in order by the shape of every 1 or a bundle or the negative electrode used as textiles A laminating is carried out on both sides of the separator which does not have electronic conduction nature and has ion conductivity between a positive electrode and a negative electrode. A positive-electrode charge collector is attached so that an end may touch at least, even if there is little fibrous material of the fibrous material laid as a positive electrode laid as a negative electrode, a negative-electrode charge collector is attached so that an end may touch, and a cell cel is filled up with the electrolytic solution and it is constituted.
[0007] Moreover, the fiber cell of this invention carries out the coat of the front face of fibrous material with electronic conduction nature with positive active material. Whether what furthermore covered the outside with the porosity matter which does not have electronic conduction nature and has ion conductivity is put in order by the shape of every 1 or a bundle Or the positive electrode used as textiles, Or the laminating of the negative electrode used as textiles is carried out. or [putting in order what carried out the coat of the front face of fibrous material with electronic conduction nature with the negative-electrode active material, and covered the outside with the porosity matter which does not have electronic conduction nature and has ion conductivity further by the shape of every 1 or a bundle] -- A negative-electrode charge collector is attached so that an end may touch at least, and it is characterized by the thing of the fibrous material of the fibrous material laid as a positive electrode which the positive-electrode charge collector was attached so that an end might touch at least, and was laid as a negative electrode which the cell cel was filled up with the electrolytic solution and constituted.
[0008] Moreover, the fiber cell of this invention carries out the coat of the front face of fibrous material with electronic conduction nature with positive active material. It considers as the warp which makes what furthermore covered the outside with the porosity matter which does not have electronic conduction nature and has ion conductivity every 1 or a bundle, and is used for a positive electrode. As the weft which carries out the coat of the front face of fibrous material with electronic conduction nature with a negative-electrode active material, makes what covered the outside with the porosity matter which does not have electronic conduction nature and has ion conductivity further every 1 or a bundle, and is used for a negative electrode The textiles which used warp and the weft as the positive electrode and the negative electrode respectively are formed, and a laminating is carried out so that these textiles may serve as the same direction in every direction. A positive-electrode charge collector is attached from both sides or one side. the direction of warp of textiles, and abbreviation -- the fibrous material of the warp which is a positive electrode in a vertical field -- so that an end may touch at least the direction of the weft of textiles, and abbreviation -- a negative-electrode charge collector is attached from both sides or one side so that an end may touch at least, and it is characterized by the thing of the fibrous material of the weft which is a negative electrode which the cell cel was filled up with the electrolytic solution and constituted in the vertical field. In addition, the fibrous material which the fibrous material used as a positive electrode uses as the weft and a negative electrode may be warp.
[0009] In the above-mentioned configuration for example, a negative-electrode active material with nickel/nickel hydroxide The cell of cadmium, [positive active material] A negative-electrode active material with nickel/nickel hydroxide The cell of a hydrogen storing metal alloy, [positive active material] A negative-electrode active material with nickel/nickel hydroxide The cell of iron/iron hydroxide, [positive active material] A negative-electrode active material with nickel/nickel hydroxide A zincky cell, [positive active material] A negative-electrode active material with a lithium/lithium compound by lead/lead dioxide A carbonaceous cell, [positive active material] [a negative-electrode active material] [a leaden cell and positive active material] A negative-electrode active material by the manganese dioxide The cell of a lithium/lithium compound, [positive active material] A negative-electrode active material with air with air The cell of

magnesium, [a positive electrode] [a negative-electrode active material] [the cell of aluminum, and a positive electrode] positive active material -- a silver oxide -- a negative-electrode active material -- a zincky cell and positive active material -- with a silver oxide, by the manganese dioxide, a negative-electrode active material can consider [a negative-electrode active material] as the cell of cadmium, and positive active material can consider as a zincky cell etc. In addition, as a cell active material applicable to this invention, nickel, iron, zinc, lead, silver, calcium, tin, gold or a lithium, aluminum, a potassium, sodium, magnesium or these oxides, a hydroxide, carbide, or a hydrogen storing metal alloy is mentioned.

[0010] Moreover, in the above-mentioned configuration, the matter which has electronic conduction nature, such as a carbon fiber and a metal fiber, for example as a fibrous material, the organic fiber which carried out metal plating to the front face, an inorganic fiber, fibrous plastics, rubber, etc. are usable. In addition, the matter of the shape of the cylindrical matter with the diameter of a cross section small enough and a long and slender foil etc. is just contained in fibrous material with electronic conduction nature other than the fibrous matter. fibrous [these] -- a cell active material is attached to the matter front face of the shape of cylindrical or a foil by the thickness of 10 micrometers or less.

[0011] Moreover, in the above-mentioned configuration, the resin which extracted the solvent from the resin which dissolved in the solvent using the resin which dissolves in a solvent meltable to water or alcohol as porosity matter which does not have electronic conduction nature and has ion conductivity, for example in water or alcohol, and was made into porosity is usable. The polyimide which dissolved in the polyamide which dissolved in water at the polyvinylidene fluoride dissolved in the polyacrylonitrile, DMF and DMSO, or the N-methyl-2-pyrrolidone (NMP) dissolved in the polysulfone, DMF and DMSO, or ethylene carbonate which dissolved in the polyether sulfone (PES) resin which dissolved in dimethyl sulfo oxide (DMSO), the polystyrene which dissolved in the acetone, dimethylformamide (DMF), or DMSO as resin which dissolved in the meltable solvent, DMF, or NMP, DMF, or NMP is used. The oxide phenylene ether (PPO) which dissolved in the cellulose acetate which dissolved in the methylene chloride, and a methylene chloride as resin which dissolved in the meltable solvent is used for alcohol. Moreover, as porosity matter which does not have electronic conduction nature and has ion conductivity, membrane film, nonwoven fabrics, etc. of a polyolefine system, such as a solid electrolyte like NAFION (trademark), Teflon (trademark), polyethylene, and polypropylene, are usable. Moreover, by attaching a cell active material to fibrous material, and newly cutting what covered that outside with the porosity matter further, the cross section of fibrous material can be exposed, a charge collector can be contacted in this cross section, and a cell can be constituted.

[0012] Moreover, in the above-mentioned configuration, the basic unit which put positive-electrode fiber and negative-electrode fiber in order, or carried out the laminating as textiles can be used as the cell with which one cel was filled up. In this case, a basic unit can be compressed and it can include in a cell cel as a consolidation condition. For example, a basic unit is bound with the band form or string-like object which consists of the insulator or the colliquative or non-colliquative insulator of porous or imperforation, and it considers as a consolidation condition. Moreover, in the above-mentioned configuration, it is possible restoration or to carry out a laminating to the same cel in the layered product which consists of fibrous material which carried out the coat of the cell active material with which charge-and-discharge properties differ to the front face. Moreover, it is also possible in a cell cel restoration or to carry out [much] a laminating in what attached to the front face of one fibrous material the cell active material with which charge-and-discharge properties differ.

[0013] Moreover, in the above-mentioned configuration, it can consider as the cell which separates and carries out the laminating of the single cel by the septum, and was made into high tension. In the above-mentioned configuration, what carried out the coat of the front face of fibrous material with the cell active material Moreover, a positive electrode, Only a positive-electrode or negative-electrode side uses what carried out the coat of the front face of fibrous material else [in the case of using a negative electrode] with the cell active material. Instead of the fibrous material which carried out the coat of the front face with the cell active material at the other pole side, it can load with the cell active material (application for patent 2001-280848) fabricated a particle, a fine-particles-like cell active material (application for patent 2001-280847), in the shape of a plate, etc., and a cell can be constituted.

[0014] The manufacture approach of the fiber cell of this invention attaches a cell active material to the front face of fibrous material with electronic conduction nature. The fibrous material which carried out the coat of the front face for the fibrous material which carried out the coat of the front face with positive active material with

the positive electrode and the negative-electrode active material is used as a negative electrode. Or consider as textiles and it covers with the separator which does not have electronic conduction nature and has ion conductivity on it. or [making fibrous material of a positive electrode into every 1 or a bundle, and putting it in order] -- Make fibrous material of a negative electrode into every 1 or a bundle, and arrange it in on a separator, or it covers as textiles. On both sides of the separator, carry out the laminating of a positive electrode and the negative electrode, and a positive-electrode charge collector is pushed from one side or both sides from the abbreviation perpendicular direction of fibrous material so that an end may touch, even if there is little fibrous material by the side of a positive electrode. It is characterized by the thing of the fibrous material by the side of a negative electrode for which a negative-electrode charge collector is pushed from one side or both sides from the abbreviation perpendicular direction of fibrous material so that an end may touch at least, a cell cel is filled up with the electrolytic solution, and a cell is completed.

[0015] Moreover, the approach of this invention attaches a cell active material to the front face of fibrous material with electronic conduction nature, and covers the outside with the porosity matter which does not have electronic conduction nature and has ion conductivity further. The fibrous material which carried out the coat of the front face with positive active material, and was further covered with porous membrane A positive electrode, The fibrous material which carried out the coat of the front face with the negative-electrode active material, and was further covered with porous membrane is used as a negative electrode. Or it covers as textiles. or [making fibrous material of a positive electrode into every 1 or a bundle, and putting it in order] -- it considering as textiles, and fibrous material of a negative electrode being made into every 1 or a bundle, and being arranged in on it, or A positive-electrode charge collector is pushed from one side or both sides from the abbreviation perpendicular direction of fibrous material. a positive electrode and a negative electrode -- alternation -- or -- random -- a laminating -- carrying out -- the fibrous material by the side of a positive electrode -- so that an end may touch at least It is characterized by the thing of the fibrous material by the side of a negative electrode for which a negative-electrode charge collector is pushed from one side or both sides from the abbreviation perpendicular direction of fibrous material so that an end may touch at least, a cell cel is filled up with the electrolytic solution, and a cell is completed.

[0016] Moreover, the approach of this invention attaches a cell active material to the front face of fibrous material with electronic conduction nature, and covers the outside with the porosity matter which does not have electronic conduction nature and has ion conductivity further. The fibrous material which carried out the coat of the front face with positive active material, and was further covered with porous membrane A positive electrode, The fibrous material which carried out the coat of the front face with the negative-electrode active material, and was further covered with porous membrane is used as a negative electrode, and fibrous material of a positive electrode is made into every 1 or a bundle, it considers as warp, and fibrous material of a negative electrode is made into every 1 or a bundle. As the weft Produce the textiles which used warp and the weft as the positive electrode and the negative electrode respectively, and the laminating of these textiles is carried out so that it may become the same direction in every direction. A positive-electrode charge collector is pushed from both sides or one side. the direction of warp of textiles, and abbreviation -- the fibrous material of the warp which is a positive electrode in a vertical field -- so that an end may touch at least the direction of the weft of textiles, and abbreviation -- it is characterized by the thing of the fibrous material of the weft which is a negative electrode for which a negative-electrode charge collector is pushed from both sides or one side so that an end may touch at least, a cell cel is filled up with the electrolytic solution, and a cell is completed in the vertical field.

[0017] the case where make into every 1 or a two or more bundle fibrous material which carried out the coat of the front face with the cell active material, or fibrous material which carried out the coat of the front face with the cell active material, and was further covered with porous membrane, and it considers as textiles -- a plain weave, twill, and a ton cap -- it can consider as textile etc. Moreover, in case a cell active material is attached on the surface of fibrous material, as a line, it is good and you may perform one at a time collectively two or more. Moreover, as an approach of attaching cell active materials (nickel hydroxide etc.) on the surface of fibrous material, the electrolytic deposition method by electrolysis is utilizable. In this case, the coat of the sludge with which properties differ can be carried out to a front face, using the electrolytic bath with which a class, concentration, and pH differ from temperature etc. two or more times. Moreover, current density can be changed and the coat of the sludge with which properties differ can be carried out to a front face. Furthermore,

it is also possible to make it suspend in an electrolytic bath, and to incorporate and carry out the eutectoid of the cell active material into a plated metal with eutectoid plating by making a cell active material into a particle.
[0018] Moreover, the approach of fixing with resin can be used as an approach of attaching cell active materials (nickel hydroxide etc.) on the surface of fibrous material. For example, when using nickel hydroxide as an active material, as resin, the thermoplastics to the softening temperature of 120 degrees C and the resin which curing temperature dissolves in the resin from ordinary temperature to 120 degrees C and a solvent with an evaporating temperature of 120 degrees C or less can be used. Since the activity is lost above 130 degrees C when using nickel hydroxide as an active material, it is required at less than 130 degrees C to perform various processings. As thermoplastics, polyethylene, polypropylene, ethylene vinyl acetate copolymer, etc. are usable, and reaction hardening mold resin (an epoxy resin, polyurethane resin, unsaturated polyester resin, etc.), heat-curing mold resin (phenol resin etc.), the above-mentioned thermoplastics, etc. have usable curing temperature as resin from ordinary temperature to 120 degrees C. What is necessary is for the above-mentioned polyethylene, polypropylene, ethylene vinyl acetate copolymer, etc. to be usable, and just to carry out heating clearance of the solvent under reduced pressure or ordinary pressure as resin which dissolves in a solvent with low evaporating temperature, after carrying out the coat of the resin which was made to dissolve these resin in organic solvents, such as heating toluene and a xylene, and dissolved in the solvent to a front face.
[0019] Moreover, PES dissolved in water as resin at DMSO which is resin which dissolved in the meltable solvent, The polysulfone dissolved in the polystyrene, DMF, or DMSO dissolved in the acetone, The polyacrylonitrile which dissolved in DMF, DMSO, or ethylene carbonate, The polyvinylidene fluoride dissolved in DMF, DMSO, or NMP, The polyimide which dissolved in the polyamide which dissolved in DMF or NMP, DMF, or NMP, What is necessary is just to carry out extract clearance of the solvent in water or alcohol, after carrying out the coat of the resin which dissolved in the meltable solvent to water or alcohol on a front face, when using for alcohol PPO dissolved in the cellulose acetate which dissolved in the methylene chloride which is resin which dissolved in the meltable solvent, and a methylene chloride.
[0020] Moreover, in order to give conductivity to resin, conductive raw materials, such as a whisker of the particle of carbon black, a carbon fiber, a carbon foil, a carbon whisker, and a nickel metal, a nickel foil, and a nickel metal, may be added to resin. There are an approach which mixes the resin and the conductive raw material which were dissolved in the solvent to resin as an approach of adding a conductive raw material, and it is made to distribute, the approach of making dissolve resin, mixing and distributing, after mixing a solvent and a conductive raw material and distributing, etc. By the approach of fixing a cell active material to a fibrous-material front face with resin, the coat of the matter with which properties differ can be carried out by changing the amount of resin or a solvent, a class, etc.
[0021] Moreover, hot dipping can be used as an approach of attaching a cell active material on the surface of fibrous material. The approach of hot dipping supplies a fibrous thing continuously, may be plated on the front face, may supply a fibrous thing in batch, and may plate it on the front face. In this case, the coat of the sludge with which properties differ can be carried out to a front face, using the electrolytic bath with which the class of presentation differs from concentration, temperature, etc. two or more times. Moreover, the processing time can be changed and the coat of the sludge with which properties differ can be carried out to a front face. Moreover, the approach of sintering can be used as an approach of attaching cell active materials (hydrogen storing metal alloy etc.) on the surface of fibrous material.
[0022]
[Embodiment of the Invention] It is possible for this invention not to be limited to the gestalt of the following operation at all, to change it suitably, and to carry out hereafter, although the gestalt of operation of this invention is explained. Drawing 1 and drawing 2 show an example of the fiber cell by the 1st gestalt of operation of this invention. The gestalt of this operation is the nickel-iron cell which attached and constituted iron/iron hydroxide as nickel/nickel hydroxide, and a negative-electrode active material as positive active material as an example in the carbon fiber which is a base material using the electrolytic deposition method by electrolysis. The example of manufacture of the fiber cell of the gestalt of this operation is explained. It electrolyzes by making a nickel plate into an anode plate in a nickel nitrate bath, making a carbon fiber as cathode, and a carbon fiber front face is made to carry out electrolytic deposition of nickel/the nickel hydroxide. The carbon fiber which carried out the coat of the front face with this nickel/nickel hydroxide is used as a positive electrode. Moreover, it electrolyzes by making a griddle into an anode plate in an iron nitrate bath,

making a carbon fiber as cathode, and a carbon fiber front face is made to carry out electrolytic deposition of iron/the iron hydroxide. The carbon fiber which carried out the coat of the front face with this iron/iron hydroxide is used as a negative electrode.

[0023] The carbon fiber 10 which carried out the coat of the positive active material to the front face is arranged in a single tier, and it covers with the film of Teflon (trademark) as a separator 12 on it. The edge which becomes a positive-electrode charge collector side arranges a location with a separator 12, after the cross section of the carbon fiber 10 of a positive electrode has been exposed, and it is made for the direction of a separator 12 to become long at the edge which becomes a negative-electrode charge collector side at this time. In addition, as a separator, textiles, a nonwoven fabric or membrane film, such as Teflon (trademark), polyethylene, polypropylene, and nylon, etc. are usable. And the carbon fiber 14 which carried out the coat of the negative-electrode active material on the front face on the separator 12 is arranged in a single tier. The edge which becomes a negative-electrode charge collector side arranges a location with a separator 12, after the cross section of the carbon fiber 14 of a negative electrode has been exposed, and it is made for the direction of a separator 12 to become long at the edge which becomes a positive-electrode charge collector side at this time. Furthermore, it covers with a separator 12 on it, and the laminating of a positive electrode and the negative electrode is carried out on both sides of the separator. The cell cel 16 is filled up with a layer-like carbon fiber, and the positive-electrode charge collector 18 is pushed against the field which arranged the carbon fiber 10 and separator 12 of a positive electrode from the right angle to the layer-like carbon fiber (perpendicular direction). In the condition of having made it the positive-electrode charge collector 18 side serve as a base, after pouring in electrolyte solutions (KOH, NaOH, LiOH, etc.), the negative-electrode charge collector 20 is pushed from the field which arranged the carbon fiber 14 and separator 12 of a negative electrode, i.e., the positive-electrode charge collector 18 and an opposite hand, and a cell is completed. In addition, in drawing 2 R> 2, the graphic display of the negative-electrode charge collector of a near side is omitted.

[0024] Below, the detail of charge and discharge is explained about the cell of the gestalt of this operation. (Charge) An electrical potential difference is applied to a cell and an electron is supplied to the negative-electrode charge collector 20 from a generation-of-electrical-energy means (not shown). An electron moves and reacts to a negative-electrode active material from the negative-electrode charge collector 20. The ion generated by the reaction passes a separator 12, reacts with positive active material, and emits an electron. This electron moves to the positive-electrode charge collector 18, and is sent to a generation-of-electrical-energy means. (Discharge) An electron is supplied to the positive-electrode charge collector 18 from a load (not shown). An electron moves and reacts to positive active material from the positive-electrode charge collector 18. The ion generated by the reaction passes a separator 12, reacts with a negative-electrode active material, and emits an electron. This electron moves to the negative-electrode charge collector 20, and is sent to a load.

[0025] Since the travel of an electron or ion becomes short as much as possible and diffusion of an electron or ion is promoted by leaps and bounds compared with the conventional cell by building a thin cell active material layer with the gestalt of this operation on the front face of fibrous material with electronic conduction nature like a carbon fiber, it can consider as the cell in which the high power the charge rate and whose discharge rate improved substantially is possible. Moreover, since the layered product of the carbon fiber which carried out the coat of the cell active material to the front face is only held down with the charge collector and is not welded, it is easily recyclable.

[0026] Drawing 3 and drawing 4 show an example of the fiber cell by the 2nd gestalt of operation of this invention. As an example, the gestalt of this operation attaches iron/iron hydroxide to the carbon fiber which is a base material using the electrolytic deposition method by electrolysis as nickel/nickel hydroxide, and a negative-electrode active material as positive active material, and is the nickel-iron cell which carried out the coat of the porosity resin to the outside, and was constituted further. The example of manufacture of the fiber cell of the gestalt of this operation is explained. It electrolyzes by making a nickel plate into an anode plate in a nickel nitrate bath, making a carbon fiber as cathode, and a carbon fiber front face is made to carry out electrolytic deposition of nickel/the nickel hydroxide. In the resin liquid made to dissolve PES in DMSO, it is immersed and the above-mentioned carbon fiber is pulled up. It considers as porous membrane by this being immersed in water, extracting DMSO with water, and solidifying PES. The carbon fiber which carried out the coat of the front face with this nickel/nickel hydroxide, and carried out the coat of the outside by porous membrane further is used as a positive electrode. Moreover, it electrolyzes by making a griddle into an anode

plate in an iron nitrate bath, making a carbon fiber as cathode, and a carbon fiber front face is made to carry out electrolytic deposition of iron/the iron hydroxide. In the resin liquid made to dissolve PES in DMSO, it is immersed and the above-mentioned carbon fiber is pulled up. It considers as porous membrane by this being immersed in water, extracting DMSO with water, and solidifying PES. The carbon fiber which carried out the coat of the front face with this iron/iron hydroxide, and carried out the coat of the outside by porous membrane further is used as a negative electrode.

[0027] The carbon fiber 22 which carried out the coat of the positive active material to the front face, and carried out the coat of the outside by porous membrane further is put in order so that the edge which arranged the location by having made the edge into the positive-electrode charge collector side, and while the cross section was exposed covered with the porous membrane 24 of another side may become a negative-electrode charge collector side. The carbon fiber 26 which carried out the coat of the negative-electrode active material to the front face, and carried out the coat of the outside by porous membrane further is put in order so that the edge which arranged the location by having made the edge into the negative-electrode charge collector side, and while the cross section was exposed covered with the porous membrane 24 of another side may become a positive-electrode charge collector side. Although a positive electrode and a negative electrode may be put in order at random, it becomes a cell with more highly efficient arranging by turns. The cell cel 16 is filled up with a layer-like carbon fiber, and the positive-electrode charge collector 18 is pushed against the cross-section side of the carbon fiber 22 used from a right angle as a positive electrode to a layer-like carbon fiber (perpendicular direction). In the condition of having made it the positive-electrode charge collector 18 side serve as a base, after pouring in the electrolytic solution, the negative-electrode charge collector 20 is pushed against the cross-section side of the carbon fiber 26 which is an opposite hand and which is used as a negative electrode, and a cell is completed.

[0028] Below, the detail of charge and discharge is explained about the cell of the gestalt of this operation.

(Charge) An electrical potential difference is applied to a cell and an electron is supplied to the negative-electrode charge collector 20 from a generation-of-electrical-energy means (not shown). An electron moves and reacts to a negative-electrode active material from the negative-electrode charge collector 20. The ion generated by the reaction passes porous membrane 24, reacts with positive active material, and emits an electron. This electron moves to the positive-electrode charge collector 18, and is sent to a generation-of-electrical-energy means.

(Discharge) An electron is supplied to the positive-electrode charge collector 18 from a load (not shown). An electron moves and reacts to positive active material from the positive-electrode charge collector 18. The ion generated by the reaction passes porous membrane 24, reacts with a negative-electrode active material, and emits an electron. This electron moves to the negative-electrode charge collector 20, and is sent to a load.

[0029] what coated with the gestalt of this operation the porosity matter which attaches a cell active material to a fibrous-material front face with electronic conduction nature, does not have electronic conduction nature in the outside further, and has ion conductivity -- alternation -- or it can be made to function as a cell only by arranging at random Other configurations and operation effectiveness are the same as that of the case of the 1st gestalt of operation.

[0030] Drawing 5 and drawing 6 show an example of the fiber cell by the 3rd gestalt of operation of this invention. As an example, by attaching iron/iron hydroxide to the carbon fiber which is a base material using the electrolytic deposition method by electrolysis as nickel/nickel hydroxide, and a negative-electrode active material as positive active material, the gestalt of this operation is the nickel-iron cell which carried out the coat of the porosity resin to the outside, and was constituted further, carries out consolidation of the basic unit strongly, and builds it into a cell cel. The example of manufacture of the fiber cell of the gestalt of this operation is explained. the approach as the 2nd gestalt of operation that the carbon fiber 22 used as a positive electrode and the carbon fiber 26 used as a negative electrode are the same -- manufacturing -- the 2nd gestalt of operation -- the same -- alternation -- or it arranges at random. As these carbon fibers are bundled and it is shown in drawing 5 , with a polypropylene band 28, it binds strongly, consolidation is carried out, and it considers as a basic unit. Although a basic unit can be bound with the insulator of porous or imperforation, or a colliquative or non-colliquative insulator and it can consider as a consolidation condition, as a porous insulator for example, polyvinyl alcohol etc. is usable as the above-mentioned polypropylene, polyethylene, and a colliquative insulator as a nonwoven fabric and an imperforation and non-colliquative insulator.

[0031] The cell cel 16 is filled up with the basic unit which carried out consolidation strongly, and the positive-electrode charge collector 18 is pushed against the cross-section side of the carbon fiber 22 used from a right angle as a positive electrode to a bundle-like carbon fiber (perpendicular direction). In the condition of having made it the positive-electrode charge collector 18 side serve as a base, after pouring in the electrolytic solution, the negative-electrode charge collector 20 is pushed against the cross-section side of the carbon fiber 26 which is an opposite hand and which is used as a negative electrode, and a cell is completed. In addition, the graphic display of a polypropylene band is omitted in drawing 6 . Improvement in the further workability can be aimed at with the gestalt of this operation. Other configurations and operation effectiveness are the same as that of the case of the 1st and 2nd gestalt of operation.

[0032] Drawing 7 shows an example of the fiber cell by the 4th gestalt of operation of this invention. The gestalt of this operation is the nickel-iron cell which constituted as textiles what attached iron/iron hydroxide to the carbon fiber which is a base material as nickel/nickel hydroxide, and a negative-electrode active material as positive active material as an example using the electrolytic deposition method by electrolysis, and carried out the coat of the porosity resin to the outside further. The example of manufacture of the fiber cell of the gestalt of this operation is explained. The carbon fiber 22 used as a positive electrode and the carbon fiber 26 used as a negative electrode are manufactured by the same approach as the 2nd gestalt of operation. It considers as the condition that the carbon fiber cross section exposed the ends of these carbon fibers. It considers as textiles 30 with a plain weave by making into the weft the carbon fiber 26 which uses the carbon fiber 22 used as a positive electrode as warp and a negative electrode. The laminating of these textiles 30 is carried out. In addition, in drawing 7 , the 16-layer laminating is carried out as an example. The cell cel 16 is loaded with the textiles 30 which carried out the laminating, the positive-electrode charge collector 18 is pushed against one cross-section side of the carbon fiber 22 used from a right angle as a positive electrode to the flat surface of textiles 30 (perpendicular direction), and the positive-electrode charge collector 18 is pushed also against the cross-section side of another side. The negative-electrode charge collector 20 is pushed against one cross-section side of the carbon fiber 26 used as the positive-electrode charge collector 18 and a right-angle side used as a negative electrode, and the negative-electrode charge collector 20 is pushed also against the cross-section side of another side. After pouring in the electrolytic solution, it covers with a lid 32 and a cell is completed. Although considered as the configuration pressed down with the charge collector from the 4th page of the direction of a right angle of textiles with the gestalt of this operation, it is also possible to consider as the cell pressed down with the charge collector from the 2nd page of the direction of a right angle of textiles or the 3rd page. 34 is an insulating member. In addition, in drawing 7 , the graphic display of the negative-electrode charge collector of a near side is omitted. Other configurations and operation effectiveness are the same as that of the case of the 1st and 2nd gestalt of operation.

[0033] Drawing 8 and drawing 9 show an example of the fiber cell by the 5th gestalt of operation of this invention. As an example, the gestalt of this operation builds four cells of the 1st gestalt of operation, they carry out a laminating to a serial, and let it be a high tension cell. Drawing 8 expands a part of single cel. in this case, the thing for which the septum 36 formed among single cels is communalized -- easy -- high-tension-izing -- possible -- in addition -- and area can consider as a cell with very little sag by considering as the large septum 36 with thin thickness. Other configurations and operation effectiveness are the same as that of the case of the 1st gestalt of operation.

[0034] Drawing 10 and drawing 11 show an example of the fiber cell by the 6th gestalt of operation of this invention. As an example, the gestalt of this operation builds four cells of the 2nd gestalt of operation, they carry out a laminating to a serial, and let it be a high tension cell. Drawing 1010 expands a part of single cel. Other configurations and operation effectiveness are the same as that of the case of the 1st, 2nd, and 5th gestalt of operation.

[0035] Drawing 12 shows an example of the fiber cell by the 7th gestalt of operation of this invention. As an example, the gestalt of this operation builds 16 cells of the 4th gestalt of operation, connects every direction 4 piece x4 piece to a serial, and uses it as a high tension cell. 38 is a connection plate and is the same role as a septum. Other configurations and operation effectiveness are the same as that of the case of the 1st, 2nd, 4th, 5th, and 6th gestalt of operation.

[0036] Drawing 13 and drawing 14 show an example of the fiber cell by the 8th gestalt of operation of this invention. The gestalt of this operation is the nickel hydoride battery which attached the hydrogen storing metal

alloy to the carbon fiber which is a base material as nickel/nickel hydroxide, and a negative-electrode active material as positive active material, carried out the coat of the porosity resin to the outside, and constituted it on it further, using resin as an example. The example of manufacture of the fiber cell of the gestalt of this operation is explained. For example, 150g (acetylene black, KETCHIEN black) of particle-like graphites is put into the Henschel mixer of 10l. of content volume, it stirs for about 3 minutes by 1000rpm, and a particle-like graphite is fully distributed. To this, 1000g of nickel hydroxide powder for cells is added, and it mixes by 1000rpm during about 3 minutes to it. 300g of ethylene vinyl acetate copolymer is added to xylene 2000g heated at 60 degrees C, and it is made to dissolve in it separately. The resin which dissolved in the heating xylene is added into the aforementioned particle-like graphite heated at 60 degrees C, and the mixture of nickel hydroxide powder, and a Henschel mixer stirs and distributes at 60 degrees C, carrying out heating maintenance. To this, it is immersed and a carbon fiber is pulled up. And a vacuum drying is carried out at 50 degrees C with a vacuum heating furnace, and a xylene is made to evaporate. Next, in the resin liquid made to dissolve PES in DMSO, it is immersed and the above-mentioned carbon fiber is pulled up. It considers as porous membrane by this being immersed in water, extracting DMSO with water, and solidifying PES. The carbon fiber which carried out the coat of the front face with this nickel/nickel hydroxide, and carried out the coat of the outside by porous membrane further is used as a positive electrode.

[0037] Moreover, for example, 150g (acetylene black, KETCHIEN black) of particle-like graphites is put into the Henschel mixer of 10l. of content volume, it stirs for about 3 minutes by 1000rpm, and a particle-like graphite is fully distributed. To this, 1000g of hydrogen storing metal alloy powder for cells is added, and it mixes by 1000rpm during about 3 minutes to it. 300g of ethylene vinyl acetate copolymer is added to xylene 2000g heated at 60 degrees C, and it is made to dissolve in it separately. The resin which dissolved in the heating xylene is added into the aforementioned particle-like graphite heated at 60 degrees C, and the mixture of a hydrogen storing metal alloy, and a Henschel mixer stirs and distributes at 60 degrees C, carrying out heating maintenance. To this, it is immersed and a carbon fiber is pulled up. And a vacuum drying is carried out at 50 degrees C with a vacuum heating furnace, and a xylene is made to evaporate. Next, in the resin liquid made to dissolve PES in DMSO, it is immersed and the above-mentioned carbon fiber is pulled up. It considers as porous membrane by this being immersed in water, extracting DMSO with water, and solidifying PES. The carbon fiber which carried out the coat of the front face with this hydrogen storing metal alloy, and carried out the coat of the outside by porous membrane further is used as a negative electrode.

[0038] The carbon fiber 22 which carried out the coat of the positive active material to the front face, and carried out the coat of the outside by porous membrane further is put in order so that the edge which arranged the location by having made the edge into the positive-electrode charge collector side, and while the cross section was exposed covered with the porous membrane 24 of another side may become a negative-electrode charge collector side. The carbon fiber 26 which carried out the coat of the negative-electrode active material to the front face, and carried out the coat of the outside by porous membrane further is put in order so that the edge which arranged the location by having made the edge into the negative-electrode charge collector side, and while the cross section was exposed covered with the porous membrane 24 of another side may become a positive-electrode charge collector side. Although a positive electrode and a negative electrode may be put in order at random, it becomes a cell with more highly efficient arranging by turns. The cell cel 16 is loaded with a layer-like carbon fiber, and the positive-electrode charge collector 18 is pushed against the cross-section side of the carbon fiber 22 used from a right angle as a positive electrode to a layer-like carbon fiber (perpendicular direction). In the condition of having made it the positive-electrode charge collector 18 side serve as a base, after pouring in the electrolytic solution, the negative-electrode charge collector 20 is pushed against the cross-section side of the carbon fiber 26 which is an opposite hand and which is used as a negative electrode, and a cell is completed. Other configurations and operation effectiveness are the same as that of the 1st and 2nd case of operation. Of course, it is also possible to apply the positive electrode of the gestalt of this operation and a negative electrode to the configuration of the 3rd, 4th, 6th, and 7th gestalt of operation.

[0039] Drawing 15 and drawing 16 show an example of the fiber cell by the 9th gestalt of operation of this invention. The gestalt of this operation is the nickel-iron cell which attached and constituted iron/iron hydroxide as nickel/nickel hydroxide, and a negative-electrode active material as positive active material as an example on the nickel fiber which is a base material using the electrolytic deposition method by electrolysis. The example of manufacture of the fiber cell of the gestalt of this operation is explained. It electrolyzes by making a nickel

plate into an anode plate in a nickel nitrate bath, making a nickel fiber as cathode, and a nickel fiber front face is made to carry out electrolytic deposition of nickel/the nickel hydroxide. The nickel fiber which carried out the coat of the front face with this nickel/nickel hydroxide is used as a positive electrode. Moreover, it electrolyzes by making a griddle into an anode plate in an iron nitrate bath, making a nickel fiber as cathode, and a nickel fiber front face is made to carry out electrolytic deposition of iron/the iron hydroxide. The nickel fiber which carried out the coat of the front face with this iron/iron hydroxide is used as a negative electrode.

[0040] The nickel fiber 40 which carried out the coat of the positive active material to the front face is arranged in a single tier, and it covers with Teflon membrane as a separator 12 on it. The edge which becomes a positive-electrode charge collector side arranges a location with a separator 12, after the cross section of the nickel fiber 40 of a positive electrode has been exposed, and it is made for the direction of a separator 12 to become long at the edge which becomes a negative-electrode charge collector side at this time. And the nickel fiber 42 which carried out the coat of the negative-electrode active material on the front face on the separator 12 is arranged in a single tier. The edge which becomes a negative-electrode charge collector side arranges a location with a separator 12, after the cross section of the nickel fiber 42 of a negative electrode has been exposed, and it is made for the direction of a separator 12 to become long at the edge which becomes a positive-electrode charge collector side at this time. Furthermore, it covers with a separator 12 on it, and the laminating of a positive electrode and the negative electrode is carried out on both sides of the separator. The cell cel 16 is loaded with a layer-like carbon fiber, and the positive-electrode charge collector 18 is pushed against the field which arranged the nickel fiber 40 and separator 12 of a positive electrode from the right angle to the layer-like carbon fiber (perpendicular direction). In the condition of having made it the positive-electrode charge collector 18 side serve as a base, after pouring in the electrolytic solution, the negative-electrode charge collector 20 is pushed from the field which arranged the nickel fiber 42 and separator 12 of a negative electrode, i.e., the positive-electrode charge collector 18 and an opposite hand, and a cell is completed. Other configurations and operation effectiveness are the same as that of the case of the 1st gestalt of operation. Of course, it is also possible to apply the positive electrode of the gestalt of this operation and a negative electrode to the configuration of the 2nd - the 7th gestalt of operation.

[0041] Drawing 17 - drawing 20 show an example of the fiber cell by the 10th gestalt of operation of this invention. What attached the cell active material to the carbon fiber which is a base material, using resin as an example is used for the gestalt of this operation as a positive electrode, and a negative-electrode side is the nickel hydoride battery which filled up with and constituted the cell active material fabricated in the shape of a plate. The example of manufacture of the fiber cell of the gestalt of this operation is explained.

(1) Put 150g (acetylene black, KETCHIEN black) of particle-like graphites into a fabrication of a negative electrode, for example, the Henschel mixer of 10l. of content volume, stir for about 3 minutes by 1000rpm, and fully distribute a particle-like graphite. To this, 2500g and 100g (trade name: Donna S-247) of carbon fibers are added, and the hydrogen storing metal alloy powder for cells is mixed by 1000rpm during about 3 minutes to it. 150g of ethylene vinyl acetate copolymer is added to xylene 1000g heated at 60 degrees C, and it is made to dissolve in it separately. The resin which dissolved in the heating xylene is added into the aforementioned hydrogen storing metal alloy powder heated at 60 degrees C, and the mixture of a conductive filler, and it stirs with a Henschel mixer, carrying out heating maintenance at 60 degrees C. Subsequently, a Henschel mixer is cooled stirring, and cooling grinding of the kneading object is carried out, and suppose that it is powdered. The particle size of a granulation particle is adjusted with a chopper, putting this powder into a high speed mixer, and stirring the whole fine particles by the agitator. A high speed mixer carries out temperature up of the temperature of fine particles to 50 degrees C from ordinary temperature, the engine speed of 600rpm and a chopper being 1500rpm, and stirring the object of 2l. capacity, and the engine speed of an agitator on this condition. After a granulation particle generates, stirring is stopped cooling. Since the particle contains the xylene, it puts this particle into a reduced-pressure-drying machine, heats it at 50 degrees C, and removes a xylene. After cooling this particle, it considers as a screen and a 1-2.88mm primary shaping particle by themm [2.88th] screen and the mm [1st] screen. The shuttering of 100mm** is filled up with 90g of primary shaping particles, and the resin (ethylene vinyl acetate copolymer) which heats at every shuttering 100 degrees C, and is contained to a primary shaping particle is softened. Subsequently, where the pressure of 0.1MPa(s) is put in shuttering, lowering and resin are stiffened for temperature. Ejection and the obtained plate-like active material 44 are used for this as a negative electrode from shuttering (drawing 17).

[0042] (2) Put 150g (acetylene black, KETCHIEN black) of particle-like graphites into a fabrication of a positive electrode, for example, the Henschel mixer of 10l. of content volume, stir for about 3 minutes by 1000rpm, and fully distribute a particle-like graphite. To this, 1000g of nickel hydroxide powder for cells is added, and it mixes by 1000rpm during about 3 minutes to it. 300g of ethylene vinyl acetate copolymer is added to xylene 2000g heated at 60 degrees C, and it is made to dissolve in it separately. The resin which dissolved in the heating xylene is added into the aforementioned particle-like graphite heated at 60 degrees C, and the mixture of nickel hydroxide powder, and a Henschel mixer stirs and distributes at 60 degrees C, carrying out heating maintenance. To this, it is immersed and a carbon fiber is pulled up. And a vacuum drying is carried out at 50 degrees C with a vacuum heating furnace, and a xylene is made to evaporate. In the carbon fiber 46 which carried out the coat of the positive active material to the front face, the fiber part which is not covered with an active material is fixed on one nickel plate, and it considers as the positive-electrode external terminal 48. The obtained fiber-like active material 50 with an external terminal is used as a positive electrode (drawing 18 R> 8).

[0043] (3) As shown in assembly drawing 19 , it placed by turning sideways the plate-like active material 44 which is a negative electrode, and also cover with a separator 12. The fiber-like active material 50 with an external terminal which is a positive electrode on it is placed, and the positive-electrode external terminal 48 is made to protrude outside. Furthermore, an insulation sheet 52 (good with a separator) is put from a top. As shown in drawing 20 , the cell cel 16 is filled up with the thing of this condition so that the negative-electrode external terminal 54 with which the plate-like active material 44 which is a negative electrode is a negative-electrode charge collector, and serves also as a cell cel may be contacted. After putting in the electrolytic solution, it covers with a lid 32 and a cell is completed. In addition, in the gestalt of this operation, a positive electrode and a negative electrode can be considered as the combination of arbitration. Moreover, it is also possible to insert the carbon fiber which carried out the coat of the front face to the cell cel filled up with the particle-like active material with the cell active material, and covered the outside with porous membrane further, and to constitute a cell.

[0044]

[Effect of the Invention] Since this invention is constituted as mentioned above, the following effectiveness is done so.

(1) What has the huge matter which must move in a cell active material in order to react, what has very small electronic conduction nature, and Since high power becomes possible by shortening a travel as much as possible, what attached the thin cell active material layer to the front face of the matter with electronic conduction nature fibrous as migration paths, such as an electron By being sufficient in a bundle, or carrying out a laminating as textiles, and constituting a cell, the cell in which the high power the charge rate and whose discharge rate improved by leaps and bounds as compared with the conventional cell is possible can be obtained.

(2) what coated the porosity matter which attaches a cell active material to a fibrous-material front face with electronic conduction nature, does not have electronic conduction nature in the outside further, and has ion conductivity -- alternation -- or it can be made to function as a cell by making it the shape of textiles and carrying out the laminating of these as it arranges at random

(3) Since what is necessary is just to hold down with a charge collector what put in order fibrous material with the electronic conduction nature which carried out the coat of the cell active material to the front face, or carried out the laminating as textiles, welding like the conventional cell is unnecessary and can be recycled easily.

(4) communalizing the septum formed among single cels, when carrying out the laminating of the single cel and considering as high tension -- easy -- high-tension-izing -- possible -- in addition -- and area can consider as a cell with very little sag by considering as a large septum with thin thickness.

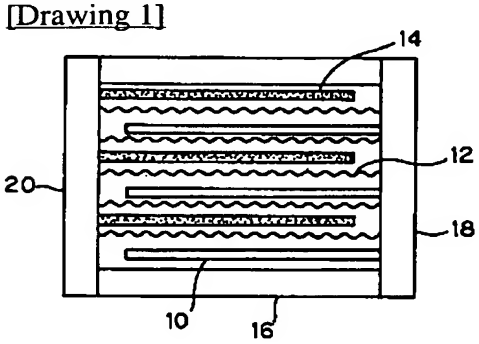
[Translation done.]

* NOTICES *

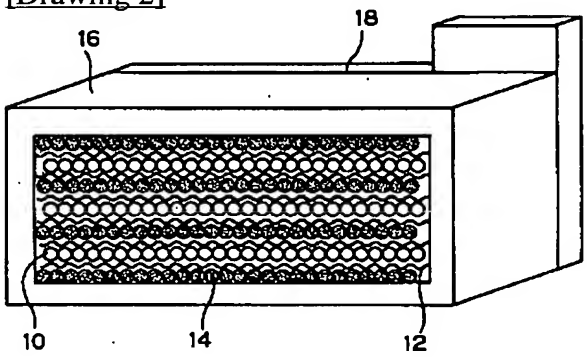
1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DRAWINGS

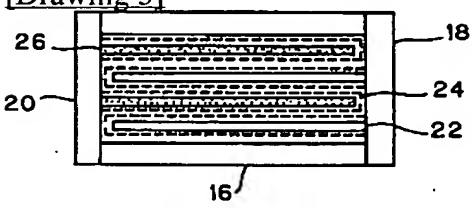
[Drawing 1]



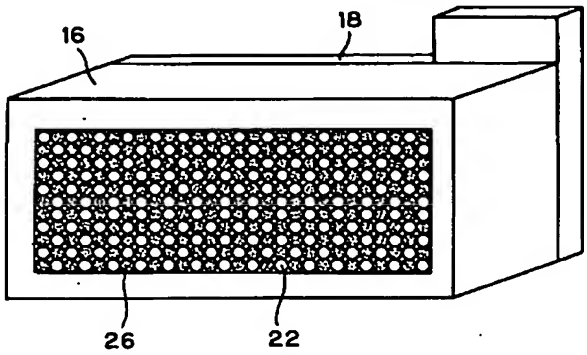
[Drawing 2]



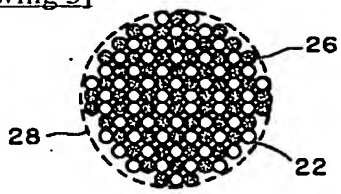
[Drawing 3]



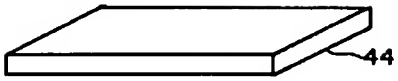
[Drawing 4]



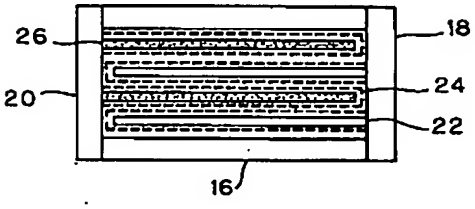
[Drawing 5]



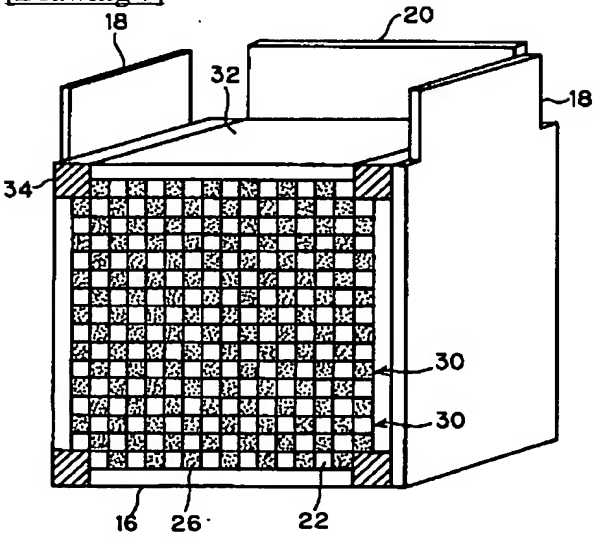
[Drawing 17]



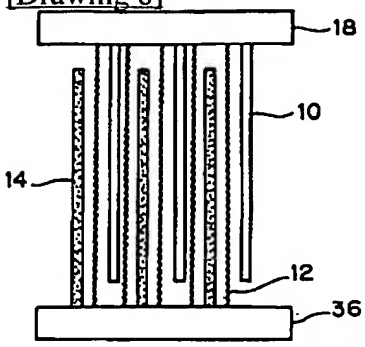
[Drawing 6]



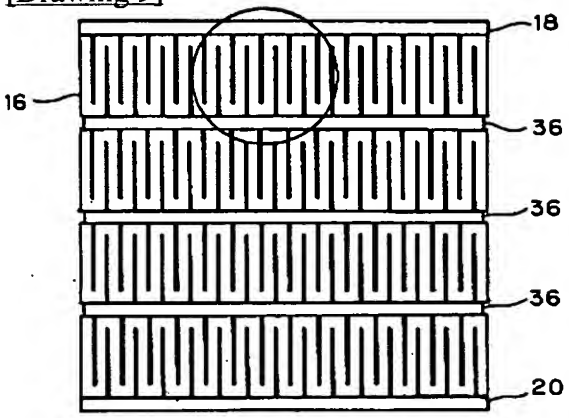
[Drawing 7]



[Drawing 8]



[Drawing 9]



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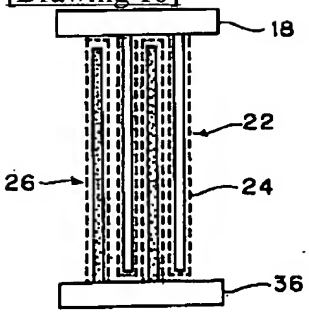

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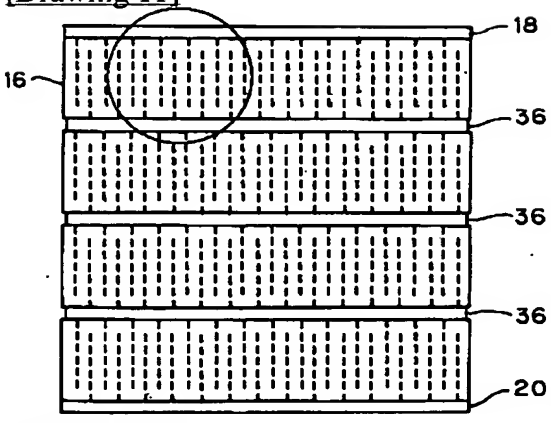
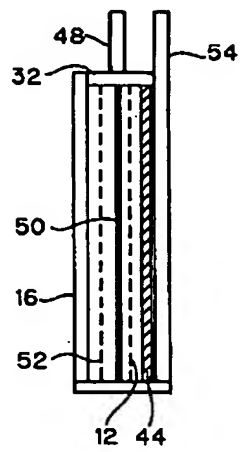


[Drawing 20]



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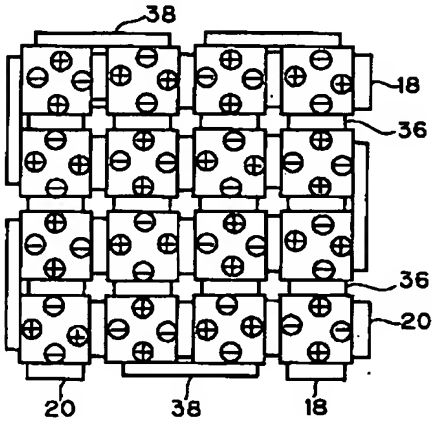
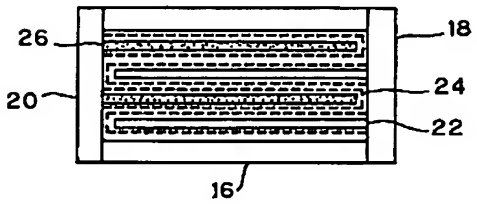
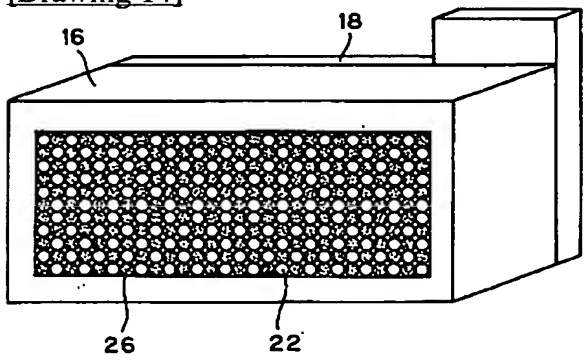


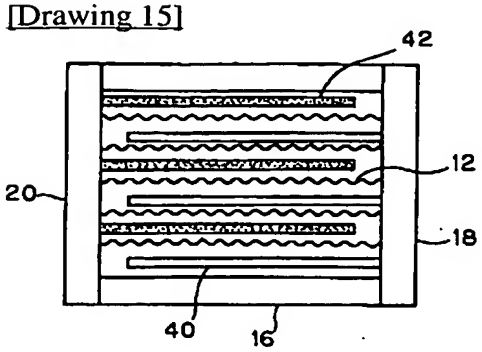
[Drawing 13]



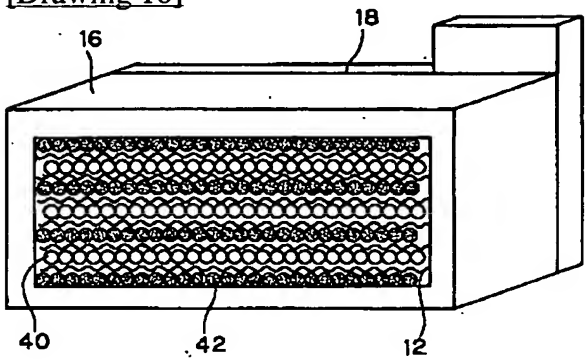
[Drawing 14]



[Drawing 15]



[Drawing 16]



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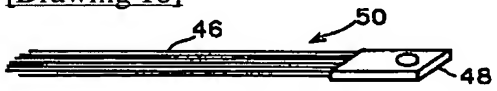
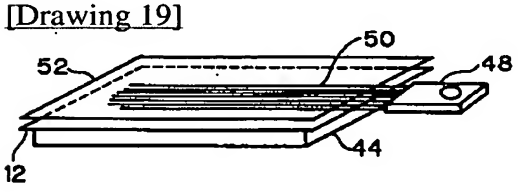


[Drawing 19]



[Translation done.]

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2/16		2/16	Ｐ	5H021
2/26		2/26	Ａ	5H022
4/02		4/02	Ｚ	5H028
4/04		4/04	Ａ	5H029

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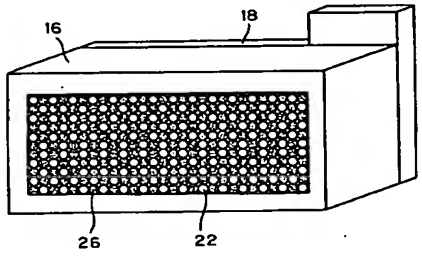
(54)【発明の名称】ファイバー電池及びその製造方法

(57)【要約】

【課題】　充電速度、放電速度ともに飛躍的に向上した電池を得る。

【解決手段】　電子伝導性のある繊維状物質の表面に電池活物質をつけたものを、束ねたり又は織物として積層するなどして電池を構成する。例えば、電子伝導性のある繊維状物質に電池活物質を接触させて固定し、それら活物質付き繊維を束ねることにより、高出力が可能な電池とする。



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【特許請求の範囲】

【請求項１】　電子伝導性のある繊維状物質の表面を正極活物質でコートしたものを１本ずつ又は束状で並べるか又は織物とした正極と、電子伝導性のある繊維状物質の表面を負極活物質でコートしたものを１本ずつ又は束状で並べるか又は織物とした負極とが、正極と負極の間に電子伝導性が無くイオン伝導性のあるセパレータを挟んで積層され、正極として敷設した繊維状物質の少なくとも一端が接するように正極集電体が取り付けられ、負極として敷設した繊維状物質の少なくとも一端が接するように負極集電体が取り付けられ、電池セルに電解液を充填して構成されたことを特徴とするファイバー電池。

【請求項２】　電子伝導性のある繊維状物質の表面を正極活物質でコートし、さらにその外側を電子伝導性が無くイオン伝導性のある多孔質な物質で被覆したものを１本ずつ又は束状で並べるか又は織物とした正極と、電子伝導性のある繊維状物質の表面を負極活物質でコートし、さらにその外側を電子伝導性が無くイオン伝導性のある多孔質な物質で被覆したものを１本ずつ又は束状で並べるか又は織物とした負極とが積層され、正極として敷設した繊維状物質の少なくとも一端が接するように正極集電体が取り付けられ、負極として敷設した繊維状物質の少なくとも一端が接するように負極集電体が取り付けられ、電池セルに電解液を充填して構成されたことを特徴とするファイバー電池。

【請求項３】　電子伝導性のある繊維状物質の表面を正極活物質でコートし、さらにその外側を電子伝導性が無くイオン伝導性のある多孔質な物質で被覆したものを１本ずつ又は束にして正極に使用する縦糸とし、電子伝導性のある繊維状物質の表面を負極活物質でコートし、さらにその外側を電子伝導性が無くイオン伝導性のある多孔質な物質で被覆したものを１本ずつ又は束にして負極に使用する横糸として、縦糸と横糸を各々正極、負極とした織物が形成され、該織物が縦横同じ向きとなるように積層されて、織物の縦糸方向と略垂直な面に正極である縦糸の繊維状物質の少なくとも一端が接するように正極集電体が両側又は片側から取り付けられ、織物の横糸方向と略垂直な面に負極である横糸の繊維状物質の少なくとも一端が接するように負極集電体が両側又は片側から取り付けられ、電池セルに電解液を充填して構成されたことを特徴とするファイバー電池。

【請求項４】　電子伝導性が無くイオン伝導性のある多孔質な物質が、水又はアルコールに可溶な溶剤に溶解する樹脂を用いて、溶剤に溶解した樹脂から水又はアルコールで溶剤を抽出して多孔質とした樹脂である請求項２又は３記載のファイバー電池。

【請求項５】　水に可溶な溶剤に溶解した樹脂が、ジメチルスルフォオキサイドに溶解したポリエーテルスルフォン樹脂、アセトンに溶解したポリスチレン、ジメチルホルムアミドもしくはジメチルスルフォオキサイドに溶解したポリスルホン、ジメチルホルムアミド、ジメチルスルフォオキサイドもしくはエチレンカーボネートに溶解したポリアクリロニトリル、ジメチルホルムアミド、ジメチルスルフォオキサイドもしくはＮ－メチルー２－ピロリドンに溶解したポリフッ化ビニリデン、ジメチルホルムアミドもしくはＮ－メチルー２－ピロリドンに溶解したポリアミド、又はジメチルホルムアミドもしくはＮ－メチルー２－ピロリドンに溶解したポリイミドであり、アルコールに可溶な溶剤に溶解した樹脂が、塩化メチレンに溶解した酢酸セルロース、又は塩化メチレンに溶解したオキサイドフェニレンエーテルである請求項４記載のファイバー電池。

【請求項６】　電子伝導性が無くイオン伝導性のある多孔質な物質が、固体電解質、テフロン（登録商標）又はポリエチレンもしくはポリプロピレンに代表されるポリオレフィン系のメンブラン膜又は不織布である請求項２又は３記載のファイバー電池。

【請求項７】　繊維状物質が、炭素繊維もしくは金属繊維に代表される電子伝導性のある物質、又は表面に金属メッキした有機繊維、無機繊維、繊維状のプラスチックもくしくはゴムである請求項１～６のいずれかに記載のファイバー電池。

【請求項８】　正極活物質がニッケル／水酸化ニッケルで負極活物質がカドミウムの電池、正極活物質がニッケル／水酸化ニッケルで負極活物質が水素吸蔵合金の電池、正極活物質がニッケル／水酸化ニッケルで負極活物質が鉄／水酸化鉄の電池、正極活物質がニッケル／水酸化ニッケルで負極活物質が亜鉛の電池、正極活物質が鉛／二酸化鉛で負極活物質が鉛の電池、正極活物質がリチウム／リチウム化合物で負極活物質が炭素の電池、正極活物質が二酸化マンガンで負極活物質がリチウム／リチウム化合物の電池、正極が空気で負極活物質がアルミニウムの電池、正極が空気で負極活物質がマグネシウムの電池、正極活物質が酸化銀で負極活物質が亜鉛の電池、正極活物質が酸化銀で負極活物質がカドミウムの電池、又は正極活物質が二酸化マンガンで負極活物質が亜鉛の電池である請求項１～７のいずれかに記載のファイバー電池。

【請求項９】　正極繊維と負極繊維を並べるか又は織物として積層した基本ユニットを、一つのセルに１個又は複数個充填した請求項１～８のいずれかに記載のファイバー電池。

【請求項１０】　基本ユニットを圧縮し圧密状態として電池セルに組み込んだ請求項９記載のファイバー電池。

【請求項１１】　基本ユニットを多孔性もしくは無孔性の絶縁体又は融解性もしくは非融解性の絶縁体からなる帯状体又は紐状体で縛り圧密状態とした請求項１０記載のファイバー電池。

【請求項１２】　充放電特性の異なる電池活物質を表面にコートした繊維状物質からなる積層体を同一セルに充

填又は積層した請求項１～１１のいずれかに記載のファイバー電池。

【請求項１３】　１本の繊維状物質の表面に充放電特性の異なる電池活物質をつけたものを電池セルに多数充填又は積層して構成した請求項１～１１のいずれかに記載のファイバー電池。

【請求項１４】　請求項１～１３のいずれかに記載の電池で構成される単セルを隔壁で隔てて積層していき高電圧としたことを特徴とするファイバー電池。

【請求項１５】　繊維状物質の表面を電池活物質でコートしたものを正極側又は負極側のみ使用し、他極側には電池活物質で表面をコートした繊維状物質の代わりに、粒子もしくは粉体状の電池活物質、又はプレート状等に成形した電池活物質を充填した請求項１～１４のいずれかに記載のファイバー電池。

【請求項１６】　電子伝導性のある繊維状物質の表面に電池活物質をつけて、正極活物質で表面をコートした繊維状物質を正極、負極活物質で表面をコートした繊維状物質を負極として使用し、正極の繊維状物質を１本ずつ又は束にして並べるか又は織物とし、その上に電子伝導性が無くイオン伝導性のあるセパレータを敷いて、セパレータの上に負極の繊維状物質を１本ずつ又は束にして並べるか又は織物として敷き、正極と負極をセパレータを挟んで積層していき、正極側の繊維状物質の少なくとも一端が接するように繊維状物質の略垂直方向より片側又は両側から正極集電体を押しつけ、負極側の繊維状物質の少なくとも一端が接するように繊維状物質の略垂直方向より片側又は両側から負極集電体を押しつけ、電池セルに電解液を充填して電池を完成させることを特徴とするファイバー電池の製造方法。

【請求項１７】　電子伝導性のある繊維状物質の表面に電池活物質をつけ、さらにその外側を電子伝導性が無くイオン伝導性のある多孔質な物質で被覆して、正極活物質で表面をコートしさらに多孔質膜で被覆した繊維状物質を正極、負極活物質で表面をコートしさらに多孔質膜で被覆した繊維状物質を負極として使用し、正極の繊維状物質を１本ずつ又は束にして並べるか又は織物とし、その上に負極の繊維状物質を１本ずつ又は束にして並べるか又は織物として敷き、正極と負極を交互にあるいはランダムに積層していき、正極側の繊維状物質の少なくとも一端が接するように繊維状物質の略垂直方向より片側又は両側から正極集電体を押しつけ、負極側の繊維状物質の少なくとも一端が接するように繊維状物質の略垂直方向より片側又は両側から負極集電体を押しつけ、電池セルに電解液を充填して電池を完成させることを特徴とするファイバー電池の製造方法。

【請求項１８】　電子伝導性のある繊維状物質の表面に電池活物質をつけ、さらにその外側を電子伝導性が無くイオン伝導性のある多孔質な物質で被覆して、正極活物質で表面をコートしさらに多孔質膜で被覆した繊維状物

質を正極、負極活物質で表面をコートしさらに多孔質膜で被覆した繊維状物質を負極として使用し、正極の繊維状物質を１本ずつ又は束にして縦糸とし、負極の繊維状物質を１本ずつ又は束にして横糸として、縦糸と横糸を各々正極、負極とした織物を作製し、該織物を縦横同じ向きとなるように積層して、織物の縦糸方向と略垂直な面に正極である縦糸の繊維状物質の少なくとも一端が接するように正極集電体を両側又は片側から押しつけ、織物の横糸方向と略垂直な面に負極である横糸の繊維状物質の少なくとも一端が接するように負極集電体を両側又は片側から押しつけ、電池セルに電解液を充填して電池を完成させることを特徴とするファイバー電池の製造方法。

【請求項１９】　電気分解による電解析出法を用いて繊維状物質の表面に電池活物質をつける請求項１６、１７又は１８記載のファイバー電池の製造方法。

【請求項２０】　電気分解による電解析出の際、電池活物質を微粒子として電解浴中に懸濁させ、共析メッキ法でメッキ金属内に電池活物質を取り込み共析させる請求項１９記載のファイバー電池の製造方法。

【請求項２１】　樹脂を使用して繊維状物質の表面に電池活物質を固定する請求項１６、１７又は１８記載のファイバー電池の製造方法。

【請求項２２】　樹脂として、ポリエチレン、ポリプロピレン及びエチレン酢酸ビニルコーポリマーの少なくともいずれかの熱可塑性樹脂、又はエポキシ樹脂、ポリウレタン樹脂及び不飽和ポリエステル樹脂の少なくともいずれかの反応硬化型樹脂、又はフェノール樹脂に代表される熱硬化型樹脂を単独で又は組み合わせて用いる請求項２１記載のファイバー電池の製造方法。

【請求項２３】　樹脂として、溶剤に溶解した樹脂である加熱トルエン又はキシレンに溶解したポリエチレン、ポリプロピレン及びエチレン酢酸ビニルコーポリマーの少なくともいずれかの熱可塑性樹脂を用い、溶剤に溶解した樹脂を表面にコートした後、減圧下又は常圧下で溶剤を加熱除去する請求項２１記載のファイバー電池の製造方法。

【請求項２４】　樹脂として、水に可溶な溶剤に溶解した樹脂であるジメチルスルフォオキサイドに溶解したポリエーテルスルフォン樹脂、アセトンに溶解したポリスチレン、ジメチルホルムアミドもしくはジメチルスルフォオキサイドに溶解したポリスルホン、ジメチルホルムアミド、ジメチルスルフォオキサイドもしくはエチレンカーボネートに溶解したポリアクリロニトリル、ジメチルホルムアミド、ジメチルスルフォオキサイドもしくはＮ－メチル－２－ピロリドンに溶解したポリフッ化ビニリデン、ジメチルホルムアミドもしくはＮ－メチル－２－ピロリドンに溶解したポリアミド、もしくはジメチルホルムアミドもしくはＮ－メチル－２－ピロリドンに溶解したポリイミド、又はアルコールに可溶な溶剤に溶解

した樹脂である塩化メチレンに溶解した酢酸セルロース、もしくは塩化メチレンに溶解したオキサイドフェニレンエーテルを用い、水又はアルコールに可溶な溶剤に溶解した樹脂を表面にコートした後、水又はアルコールで溶剤を抽出除去する請求項２１記載のファイバー電池の製造方法。

【請求項２５】　樹脂に導電性を持たせるため、カーボンブラック、炭素繊維、炭素箔、炭素ウィスカー、ニッケル金属の微粒子、ニッケル箔及びニッケル金属のウィスカーの少なくともいずれかの導電性素材を樹脂に添加する請求項２１～２４のいずれかに記載のファイバー電池の製造方法。

【請求項２６】　樹脂に導電性素材を添加する方法として、溶剤に溶解させた樹脂と導電性素材を混合し分散させるか、又は溶剤と導電性素材を混合し分散した後に樹脂を溶解させて混合し分散させる請求項２５記載のファイバー電池の製造方法。

【請求項２７】　溶融メッキにより繊維状物質の表面に電池活物質をつける請求項１６、１７又は１８記載のファイバー電池の製造方法。

【請求項２８】　焼結により繊維状物質の表面に電池活物質をつける請求項１６、１７又は１８記載のファイバー電池の製造方法。

【請求項２９】　電池活物質で表面をコートした繊維状物質を被覆する電子伝導性が無くイオン伝導性のある多孔質な物質として、水又はアルコールに可溶な溶剤に溶解した樹脂を用い、水又はアルコールに可溶な溶剤に溶解した樹脂を表面にコートした後、水又はアルコールで溶剤を抽出除去する請求項１７又は１８記載のファイバー電池の製造方法。

【請求項３０】　繊維状物質に電池活物質をつけ、さらにその外側を多孔質な物質で被覆したものを、切断することにより、繊維状物質の断面を露出させて該断面に集電体を接触させる請求項１７、１８又は２９記載のファイバー電池の製造方法。

【発明の詳細な説明】

【０００１】

【発明の属する技術分野】本発明は、電子伝導性のある繊維状物質の表面に電池活物質をつけたものを、束ねたり又は織物として積層するなどして構成した高出力が可能なファイバー電池及びその製造方法に関するものである。

【０００２】

【従来の技術】特許第３０５１４０１号公報には、電池活物質を粉体又は粒子にして構成した、いわゆる三次元電池が開示されている。また、積層化された三次元電池についても既に特許出願がなされている（特願平１１－３０９６２７）。また、粒子状活物質を充填して固定層とした三次元電池についても、本出願人が特許出願している（特願２０００－３３２２８１、特願２０００－３３２５０３）。さらに、活物質材料粉末に導電フィラーを加えて樹脂で粒子状等に成形し硬化させた電池活物質（特願２００１－２８０８４７）や、活物質材料粉末に導電フィラーを加え樹脂で硬化させた一次成形体をプレート状等に二次成形した電池活物質（特願２００１－２８０８４８）についても、本出願人が特許出願している。

【０００３】

【発明が解決しようとする課題】例えば、従来から知られているニッケル水素電池やニッケル鉄電池の電池活物質の厚みは１㎜前後であり、活物質内をイオンや電子が移動する拡散が律速になっているので、高出力化が難しい。そこで、従来は、電子伝導性の無い水酸化ニッケルに電子伝導性を持たせるために、コバルトの添加や多孔性金属への充填が行われている。また、例えば、リチウムイオン電池の電池活物質の厚みは１００μm前後であり、リチウムイオンの拡散が律速になっているので、高出力化が難しい。この場合、リチウムイオンはプロトンと比較すると極めて巨大なので、移動距離を短くするしか短時間でリチウムを移動させる方法はない。

【０００４】また、例えば、鉛蓄電池の活物質である鉛、二酸化鉛の厚みは１㎜前後であり、活物質でもある電解液の硫酸イオンが巨大で、硫酸イオンの移動が律速になっている。この場合、二酸化鉛は電子伝導性が低いので、薄くするしか反応速度を上げる方法はないが、無理やり厚みを薄くすると大電流を流したときに電圧降下が激しく起こる。さらに、従来の電池では、電池活物質が接触しているニッケルなどの導電材と集電体が溶接されており、リサイクルが困難である。

【０００５】本発明は上記の諸点に鑑みなされたもので、電池活物質において電子伝導性が極めて小さいものや反応するために移動しなければならない物質が巨大なものは、移動距離を極力短くすることで高出力が可能になるので、電子等の移動通路として繊維状の電子伝導性のある物質の表面に薄い電池活物質層をつけたものを、束ねたり又は織物として積層するなどして電池を構成することにより、従来にない高出力が可能なファイバー電池及びその製造方法を提供することを目的とする。また、電池活物質を表面にコートした電子伝導性のある繊維状物質を並べたり織物として積層したものを集電体で押さえ込むだけの構成とすることにより、従来のような溶接の必要がなくなり、容易にリサイクルができるファイバー電池及びその製造方法を提供することを目的とする。

【０００６】

【課題を解決するための手段】上記の目的を達成するために、本発明のファイバー電池は、電子伝導性のある繊維状物質の表面を正極活物質でコートしたものを１本ずつ又は束状で並べるか又は織物とした正極と、電子伝導性のある繊維状物質の表面を負極活物質でコートしたも

のを１本ずつ又は束状で並べるか又は織物とした負極とが、正極と負極の間に電子伝導性が無くイオン伝導性のあるセパレータを挟んで積層され、正極として敷設した繊維状物質の少なくとも一端が接するように正極集電体が取り付けられ、負極として敷設した繊維状物質の少なくとも一端が接するように負極集電体が取り付けられ、電池セルに電解液を充填して構成されている。

【０００７】また、本発明のファイバー電池は、電子伝導性のある繊維状物質の表面を正極活物質でコートし、さらにその外側を電子伝導性が無くイオン伝導性のある多孔質な物質で被覆したものを１本ずつ又は束状で並べるか又は織物とした正極と、電子伝導性のある繊維状物質の表面を負極活物質でコートし、さらにその外側を電子伝導性が無くイオン伝導性のある多孔質な物質で被覆したものを１本ずつ又は束状で並べるか又は織物とした負極とが積層され、正極として敷設した繊維状物質の少なくとも一端が接するように正極集電体が取り付けられ、負極として敷設した繊維状物質の少なくとも一端が接するように負極集電体が取り付けられ、電池セルに電解液を充填して構成されたことを特徴としている。

【０００８】また、本発明のファイバー電池は、電子伝導性のある繊維状物質の表面を正極活物質でコートし、さらにその外側を電子伝導性が無くイオン伝導性のある多孔質な物質で被覆したものを１本ずつ又は束にして正極に使用する縦糸とし、電子伝導性のある繊維状物質の表面を負極活物質でコートし、さらにその外側を電子伝導性が無くイオン伝導性のある多孔質な物質で被覆したものを１本ずつ又は束にして負極に使用する横糸として、縦糸と横糸を各々正極、負極とした織物が形成され、該織物が縦横同じ向きとなるように積層されて、織物の縦糸方向と略垂直な面に正極である縦糸の繊維状物質の少なくとも一端が接するように正極集電体が両側又は片側から取り付けられ、織物の横糸方向と略垂直な面に負極である横糸の繊維状物質の少なくとも一端が接するように負極集電体が両側又は片側から取り付けられ、電池セルに電解液を充填して構成されたことを特徴としている。なお、正極として使用する繊維状物質が横糸、負極として使用する繊維状物質が縦糸であってもよい。

【０００９】上記の構成においては、例えば、正極活物質がニッケル／水酸化ニッケルで負極活物質がカドミウムの電池、正極活物質がニッケル／水酸化ニッケルで負極活物質が水素吸蔵合金の電池、正極活物質がニッケル／水酸化ニッケルで負極活物質が鉄／水酸化鉄の電池、正極活物質がニッケル／水酸化ニッケルで負極活物質が亜鉛の電池、正極活物質が鉛／二酸化鉛で負極活物質が鉛の電池、正極活物質がリチウム／リチウム化合物で負極活物質が炭素の電池、正極活物質が二酸化マンガンで負極活物質がリチウム／リチウム化合物の電池、正極が空気で負極活物質がアルミニウムの電池、正極が空気で負極活物質がマグネシウムの電池、正極活物質が酸化銀で負極活物質が亜鉛の電池、正極活物質が酸化銀で負極活物質がカドミウムの電池、正極活物質が二酸化マンガンで負極活物質が亜鉛の電池などとすることができる。なお、本発明に適用可能な電池活物質としては、ニッケル、鉄、亜鉛、鉛、銀、カルシウム、錫、金、あるいはリチウム、アルミニウム、カリウム、ナトリウム、マグネシウム、あるいはこれらの酸化物、水酸化物、炭化物、又は水素吸蔵合金などが挙げられる。

【００１０】また、上記の構成においては、例えば、繊維状物質として、炭素繊維、金属繊維などの電子伝導性のある物質、表面に金属メッキした有機繊維、無機繊維、繊維状のプラスチック、ゴムなどが使用可能である。なお、電子伝導性のある繊維状物質には、まさに繊維状である物質の他に、断面径が十分に小さい棒状物質、細長い箔状の物質なども含まれる。これらの繊維状、棒状あるいは箔状の物質表面に、例えば、１０μｍ以下の厚みで電池活物質をつける。

【００１１】また、上記の構成においては、例えば、電子伝導性が無くイオン伝導性のある多孔質な物質として、水又はアルコールに可溶な溶剤に溶解する樹脂を用いて、溶剤に溶解した樹脂から水又はアルコールで溶剤を抽出して多孔質とした樹脂が使用可能である。水に可溶な溶剤に溶解した樹脂としては、ジメチルスルフォオキサイド（ＤＭＳＯ）に溶解したポリエーテルスルフォン（ＰＥＳ）樹脂、アセトンに溶解したポリスチレン、ジメチルホルムアミド（ＤＭＦ）もしくはＤＭＳＯに溶解したポリスルホン、ＤＭＦ、ＤＭＳＯもしくはエチレンカーボネートに溶解したポリアクリロニトリル、ＤＭＦ、ＤＭＳＯもしくはＮ－メチル－２－ピロリドン（ＮＭＰ）に溶解したポリフッ化ビニリデン、ＤＭＦもしくはＮＭＰに溶解したポリアミド、ＤＭＦもしくはＮＭＰに溶解したポリイミドなどが用いられる。アルコールに可溶な溶剤に溶解した樹脂としては、塩化メチレンに溶解した酢酸セルロース、塩化メチレンに溶解したオキサイドフェニレンエーテル（ＰＰＯ）などが用いられる。また、電子伝導性が無くイオン伝導性のある多孔質な物質としては、ＮＡＦＩＯＮ（登録商標）のような固体電解質、テフロン（登録商標）、ポリエチレン、ポリプロピレンなどのポリオレフィン系のメンブラン膜や不織布などが使用可能である。また、繊維状物質に電池活物質をつけ、さらにその外側を多孔質な物質で被覆したものを、新たに切断することにより、繊維状物質の断面を露出させて、この断面に集電体を接触させて電池を構成することができる。

【００１２】また、上記の構成においては、正極繊維と負極繊維を並べるか又は織物として積層した基本ユニットを、一つのセルに１個又は複数個充填した電池とすることができる。この場合、基本ユニットを圧縮し圧密状態として電池セルに組み込むことができる。例えば、基本ユニットを多孔性もしくは無孔性の絶縁体又は融解性

もしくは非融解性の絶縁体からなる帯状体又は紐状体で縛り圧密状態とする。また、上記の構成においては、充放電特性の異なる電池活物質を表面にコートした繊維状物質からなる積層体を同一セルに充填又は積層することが可能である。また、１本の繊維状物質の表面に充放電特性の異なる電池活物質をつけたものを電池セルに多数充填又は積層することも可能である。

【００１３】また、上記の構成においては、単セルを隔壁で隔てて積層していき、高電圧とした電池とすることができる。また、上記の構成においては、繊維状物質の表面を電池活物質でコートしたものを正極、負極ともに使用する場合の他に、繊維状物質の表面を電池活物質でコートしたものを正極側又は負極側のみ使用し、他極側には電池活物質で表面をコートした繊維状物質の代わりに、粒子もしくは粉体状の電池活物質（特願２００１－２８０８４７）、又はプレート状等に成形した電池活物質（特願２００１－２８０８４８）を装填して電池を構成することができる。

【００１４】本発明のファイバー電池の製造方法は、電子伝導性のある繊維状物質の表面に電池活物質をつけて、正極活物質で表面をコートした繊維状物質を正極、負極活物質で表面をコートした繊維状物質を負極として使用し、正極の繊維状物質を１本ずつ又は束にして並べるか又は織物とし、その上に電子伝導性が無くイオン伝導性のあるセパレータを敷いて、セパレータの上に負極の繊維状物質を１本ずつ又は束にして並べるか又は織物として敷き、正極と負極をセパレータを挟んで積層していき、正極側の繊維状物質の少なくとも一端が接するように繊維状物質の略垂直方向より片側又は両側から正極集電体を押しつけ、負極側の繊維状物質の少なくとも一端が接するように繊維状物質の略垂直方向より片側又は両側から負極集電体を押しつけ、電池セルに電解液を充填して電池を完成させることを特徴としている。

【００１５】また、本発明の方法は、電子伝導性のある繊維状物質の表面に電池活物質をつけ、さらにその外側を電子伝導性が無くイオン伝導性のある多孔質な物質で被覆して、正極活物質で表面をコートしさらに多孔質膜で被覆した繊維状物質を正極、負極活物質で表面をコートしさらに多孔質膜で被覆した繊維状物質を負極として使用し、正極の繊維状物質を１本ずつ又は束にして並べるか又は織物とし、その上に負極の繊維状物質を１本ずつ又は束にして並べるか又は織物として敷き、正極と負極を交互にあるいはランダムに積層していき、正極側の繊維状物質の少なくとも一端が接するように繊維状物質の略垂直方向より片側又は両側から正極集電体を押しつけ、負極側の繊維状物質の少なくとも一端が接するように繊維状物質の略垂直方向より片側又は両側から負極集電体を押しつけ、電池セルに電解液を充填して電池を完成させることを特徴としている。

【００１６】また、本発明の方法は、電子伝導性のある繊維状物質の表面に電池活物質をつけ、さらにその外側を電子伝導性が無くイオン伝導性のある多孔質な物質で被覆して、正極活物質で表面をコートしさらに多孔質膜で被覆した繊維状物質を正極、負極活物質で表面をコートしさらに多孔質膜で被覆した繊維状物質を負極として使用し、正極の繊維状物質を１本ずつ又は束にして縦糸とし、負極の繊維状物質を１本ずつ又は束にして横糸として、縦糸と横糸を各々正極、負極とした織物を作製し、該織物を縦横同じ向きとなるように積層して、織物の縦糸方向と略垂直な面に正極である縦糸の繊維状物質の少なくとも一端が接するように正極集電体を両側又は片側から押しつけ、織物の横糸方向と略垂直な面に負極である横糸の繊維状物質の少なくとも一端が接するように負極集電体を両側又は片側から押しつけ、電池セルに電解液を充填して電池を完成させることを特徴としている。

【００１７】電池活物質で表面をコートした繊維状物質、又は電池活物質で表面をコートしさらに多孔質膜で被覆した繊維状物質を１本ずつ、あるいは複数本束にして織物とする場合は、平織り、綾織り、トンキャップ織り等とすることができる。また、繊維状物質の表面に電池活物質をつける際は、１本ずつ行ってもよいし、複数本まとめて行ってもよい。また、繊維状物質の表面に電池活物質（水酸化ニッケルなど）をつける方法としては、電気分解による電解析出法を活用することができる。この場合、種類や濃度、pH、温度等が異なる電解浴を複数回用いて、特性の異なる析出物を表面にコートすることができる。また、電流密度を変化させて、特性の異なる析出物を表面にコートすることができる。さらに、電池活物質を微粒子として電解浴中に懸濁させ、共析メッキ法でメッキ金属内に電池活物質を取り込み共析させることも可能である。

【００１８】また、繊維状物質の表面に電池活物質（水酸化ニッケルなど）をつける方法として、樹脂により固定する方法を用いることができる。例えば、活物質として水酸化ニッケルを使用する場合、樹脂としては、軟化温度１２０℃までの熱可塑性樹脂、硬化温度が常温から１２０℃までの樹脂、蒸発温度１２０℃以下の溶剤に溶解する樹脂を用いることができる。活物質として水酸化ニッケルを使用する場合は、１３０℃以上でその活性を失うため、１３０℃未満で各種処理を行うことが必要である。熱可塑性樹脂としては、ポリエチレン、ポリプロピレン、エチレン酢酸ビニルコーポリマーなどが使用可能であり、硬化温度が常温から１２０℃までの樹脂としては、反応硬化型樹脂（エポキシ樹脂、ポリウレタン樹脂、不飽和ポリエステル樹脂など）、熱硬化型樹脂（フェノール樹脂など）、上記の熱可塑性樹脂などが使用可能である。蒸発温度が低い溶剤に溶解する樹脂としては、上記のポリエチレン、ポリプロピレン、エチレン酢酸ビニルコーポリマーなどが使用可能であり、これらの

樹脂を加熱トルエン、キシレン等の有機溶剤に溶解させて、溶剤に溶解した樹脂を表面にコートした後、減圧下又は常圧下で溶剤を加熱除去すればよい。

【００１９】また、樹脂として、水に可溶な溶剤に溶解した樹脂であるＤＭＳＯに溶解したＰＥＳ、アセトンに溶解したポリスチレン、ＤＭＦもしくはＤＭＳＯに溶解したポリスルホン、ＤＭＦ、ＤＭＳＯもしくはエチレンカーボネートに溶解したポリアクリロニトリル、ＤＭＦ、ＤＭＳＯもしくはＮＭＰに溶解したポリフッ化ビニリデン、ＤＭＦもしくはＮＭＰに溶解したポリアミド、ＤＭＦもしくはＮＭＰに溶解したポリイミドなど、アルコールに可溶な溶剤に溶解した樹脂である塩化メチレンに溶解した酢酸セルロース、塩化メチレンに溶解したＰＰＯなどを用いる場合は、水又はアルコールに可溶な溶剤に溶解した樹脂を表面にコートした後、水又はアルコールで溶剤を抽出除去すればよい。

【００２０】また、樹脂に導電性を持たせるため、カーボンブラック、炭素繊維、炭素箔、炭素ウィスカー、ニッケル金属の微粒子、ニッケル箔、ニッケル金属のウィスカーなどの導電性素材を樹脂に添加してもよい。樹脂に導電性素材を添加する方法としては、溶剤に溶解させた樹脂と導電性素材を混合し分散させる方法や、溶剤と導電性素材を混合し分散した後に樹脂を溶解させて混合し分散させる方法などがある。樹脂により繊維状物質表面に電池活物質を固定する方法では、樹脂や溶剤の量、種類等を変えることで、特性の異なる物質をコートすることができる。

【００２１】また、繊維状物質の表面に電池活物質をつける方法として、溶融メッキを用いることができる。溶融メッキの方法は、繊維状のものを連続的に供給してその表面にメッキしてもよいし、繊維状のものをバッチで供給してその表面にメッキしてもよい。この場合、組成の種類や濃度、温度等が異なる電解浴を複数回用いて、特性の異なる析出物を表面にコートすることができる。また、処理時間を変化させて、特性の異なる析出物を表面にコートすることができる。また、繊維状物質の表面に電池活物質（水素吸蔵合金など）をつける方法として、焼結する方法を用いることができる。

【００２２】

【発明の実施の形態】以下、本発明の実施の形態について説明するが、本発明は下記の実施の形態に何ら限定されるものではなく、適宜変更して実施することが可能なものである。図１、図２は、本発明の実施の第１形態によるファイバー電池の一例を示している。本実施の形態は、一例として、電気分解による電解析出法を用いて、基材であるカーボンファイバーに正極活物質としてニッケル／水酸化ニッケル、負極活物質として鉄／水酸化鉄をつけて構成したニッケル－鉄電池である。本実施の形態のファイバー電池の製造例について説明する。硝酸ニッケル浴中でカーボンファイバーを陰極、ニッケル板を陽極として電気分解を行い、カーボンファイバー表面にニッケル／水酸化ニッケルを電解析出させる。このニッケル／水酸化ニッケルで表面をコートしたカーボンファイバーを正極として使用する。また、硝酸鉄浴中でカーボンファイバーを陰極、鉄板を陽極として電気分解を行い、カーボンファイバー表面に鉄／水酸化鉄を電解析出させる。この鉄／水酸化鉄で表面をコートしたカーボンファイバーを負極として使用する。

【００２３】正極活物質を表面にコートしたカーボンファイバー１０を一列に並べて、その上にセパレータ１２としてテフロン（登録商標）の膜を敷く。このとき、正極集電体側となる端は正極のカーボンファイバー１０の断面が露出した状態でセパレータ１２とともに位置を揃えて、負極集電体側となる端ではセパレータ１２の方が長くなるようにする。なお、セパレータとしては、テフロン（登録商標）、ポリエチレン、ポリプロピレン、ナイロンなどの織物や不織布又はメンブラン膜等が使用可能である。そして、セパレータ１２の上に負極活物質を表面にコートしたカーボンファイバー１４を一列に並べる。このとき、負極集電体側となる端は負極のカーボンファイバー１４の断面が露出した状態でセパレータ１２とともに位置を揃えて、正極集電体側となる端ではセパレータ１２の方が長くなるようにする。さらにその上にセパレータ１２を敷き、正極と負極をセパレータを挟んで積層していく。層状のカーボンファイバーを電池セル１６に充填し、層状のカーボンファイバーに対して直角方向（垂直方向）から正極のカーボンファイバー１０とセパレータ１２を揃えた面に正極集電体１８を押しつける。正極集電体１８側が底面となるようにした状態で、電解質（ＫＯＨ、ＮａＯＨ、ＬｉＯＨ等）溶液を注入した後、負極のカーボンファイバー１４とセパレータ１２を揃えた面、すなわち、正極集電体１８と反対側から負極集電体２０を押しつけて電池を完成させる。なお、図２では、手前側の負極集電体の図示を省略している。

【００２４】つぎに、本実施の形態の電池について充電及び放電の詳細を説明する。

（充電）電池に電圧をかけ、発電手段（図示せず）から負極集電体２０へ電子を供給する。電子は負極集電体２０より負極活物質に移動して反応する。反応によって発生したイオンはセパレータ１２を通過し、正極活物質と反応して電子を放出する。この電子は正極集電体１８に移動して発電手段に送られる。

（放電）負荷（図示せず）から正極集電体１８へ電子が供給される。電子は正極集電体１８より正極活物質に移動し反応する。反応によって発生したイオンはセパレータ１２を通過し、負極活物質と反応して電子を放出する。この電子は負極集電体２０に移動して負荷に送られる。

【００２５】本実施の形態では、カーボンファイバーのような電子伝導性のある繊維状物質の表面に薄い電池活

物質層をつくることで、電子やイオンの移動距離が極力短くなり、電子やイオンの拡散が従来の電池と比べて飛躍的に促進されるので、充電速度、放電速度とも大幅に向上した高出力が可能な電池とすることができる。また、電池活物質を表面にコートしたカーボンファイバーの積層体は集電体で押さえ込んでいるだけで、溶接されていないので、容易にリサイクルできる。

【００２６】図３、図４は、本発明の実施の第２形態によるファイバー電池の一例を示している。本実施の形態は、一例として、電気分解による電解析出法を用いて、基材であるカーボンファイバーに正極活物質としてニッケル／水酸化ニッケル、負極活物質として鉄／水酸化鉄をつけ、さらにその外側に多孔質樹脂をコートして構成したニッケル－鉄電池である。本実施の形態のファイバー電池の製造例について説明する。硝酸ニッケル浴中でカーボンファイバーを陰極、ニッケル板を陽極として電気分解を行い、カーボンファイバー表面にニッケル／水酸化ニッケルを電解析出させる。ＰＥＳをＤＭＳＯに溶解させた樹脂液に上記のカーボンファイバーを浸漬して引き上げる。これを水に浸漬し、ＤＭＳＯを水で抽出しＰＥＳを固化することで多孔質膜とする。このニッケル／水酸化ニッケルで表面をコートし、さらに外側を多孔質膜でコートしたカーボンファイバーを正極として使用する。また、硝酸鉄浴中でカーボンファイバーを陰極、鉄板を陽極として電気分解を行い、カーボンファイバー表面に鉄／水酸化鉄を電解析出させる。ＰＥＳをＤＭＳＯに溶解させた樹脂液に上記のカーボンファイバーを浸漬して引き上げる。これを水に浸漬し、ＤＭＳＯを水で抽出しＰＥＳを固化することで多孔質膜とする。この鉄／水酸化鉄で表面をコートし、さらに外側を多孔質膜でコートしたカーボンファイバーを負極として使用する。

【００２７】正極活物質を表面にコートしさらに外側を多孔質膜でコートしたカーボンファイバー２２を、断面が露出した一方の端を正極集電体側として位置を揃え、他方の多孔質膜２４で被覆した端が負極集電体側となるように並べる。負極活物質を表面にコートしさらに外側を多孔質膜でコートしたカーボンファイバー２６を、断面が露出した一方の端を負極集電体側として位置を揃え、他方の多孔質膜２４で被覆した端が正極集電体側となるように並べる。正極と負極はランダムに並べてもかまわないが、交互に並べた方がより高性能な電池となる。層状のカーボンファイバーを電池セル１６に充填し、層状のカーボンファイバーに対して直角方向（垂直方向）から正極として使用するカーボンファイバー２２の断面側に正極集電体１８を押しつける。正極集電体１８側が底面となるようにした状態で、電解液を注入した後、反対側である、負極として使用するカーボンファイバー２６の断面側に負極集電体２０を押しつけて電池を完成させる。

【００２８】つぎに、本実施の形態の電池について充電及び放電の詳細を説明する。

（充電）電池に電圧をかけ、発電手段（図示せず）から負極集電体２０へ電子を供給する。電子は負極集電体２０より負極活物質に移動して反応する。反応によって発生したイオンは多孔質膜２４を通過し、正極活物質と反応して電子を放出する。この電子は正極集電体１８に移動して発電手段に送られる。

（放電）負荷（図示せず）から正極集電体１８へ電子が供給される。電子は正極集電体１８より正極活物質に移動し反応する。反応によって発生したイオンは多孔質膜２４を通過し、負極活物質と反応して電子を放出する。この電子は負極集電体２０に移動して負荷に送られる。

【００２９】本実施の形態では、電子伝導性のある繊維状物質表面に電池活物質をつけ、さらにその外側に電子伝導性がなくイオン伝導性のある多孔質な物質をコーティングしたものを、交互にあるいはランダムに並べるだけで電池として機能させることができる。他の構成及び作用効果は、実施の第１形態の場合と同様である。

【００３０】図５、図６は、本発明の実施の第３形態によるファイバー電池の一例を示している。本実施の形態は、一例として、電気分解による電解析出法を用いて、基材であるカーボンファイバーに正極活物質としてニッケル／水酸化ニッケル、負極活物質として鉄／水酸化鉄をつけ、さらにその外側に多孔質樹脂をコートして構成したニッケル－鉄電池であって、基本ユニットを強く圧密して電池セルに組み込んだものである。本実施の形態のファイバー電池の製造例について説明する。正極として使用するカーボンファイバー２２、負極として使用するカーボンファイバー２６は、実施の第２形態と同じ方法で製作し、実施の第２形態と同様に交互にあるいはランダムに並べる。これらのカーボンファイバーを束ねて、図５に示すように、ポリプロピレンバンド２８で強く縛って圧密し基本ユニットとする。基本ユニットは、多孔性もしくは無孔性の絶縁体、又は融解性もしくは非融解性の絶縁体で縛り圧密状態とすることができるが、例えば、多孔性の絶縁体としては不織布、無孔性で非融解性の絶縁体としては上記のポリプロピレン、ポリエチレン、融解性の絶縁体としてはポリビニルアルコール等が使用可能である。

【００３１】強く圧密した基本ユニットを電池セル１６に充填し、束状のカーボンファイバーに対して直角方向（垂直方向）から正極として使用するカーボンファイバー２２の断面側に正極集電体１８を押しつける。正極集電体１８側が底面となるようにした状態で、電解液を注入した後、反対側である、負極として使用するカーボンファイバー２６の断面側に負極集電体２０を押しつけて電池を完成させる。なお、図６ではポリプロピレンバンドの図示を省略している。本実施の形態では、さらなる作業性の向上が図れる。他の構成及び作用効果は、実施の第１、第２形態の場合と同様である。

【００３２】図７は、本発明の実施の第４形態によるファイバー電池の一例を示している。本実施の形態は、一例として、電気分解による電解析出法を用いて、基材であるカーボンファイバーに正極活物質としてニッケル／水酸化ニッケル、負極活物質として鉄／水酸化鉄をつけ、さらにその外側に多孔質樹脂をコートしたものを織物として構成したニッケル－鉄電池である。本実施の形態のファイバー電池の製造例について説明する。正極として使用するカーボンファイバー２２、負極として使用するカーボンファイバー２６は、実施の第２形態と同じ方法で製作する。これらのカーボンファイバーの両端をカーボンファイバー断面が露出した状態とする。正極として使用するカーボンファイバー２２を縦糸、負極として使用するカーボンファイバー２６を横糸として平織りにて織物３０とする。この織物３０を積層していく。なお、図７では、一例として、１６層積層している。積層した織物３０を電池セル１６に装填し、織物３０の平面に対して直角方向（垂直方向）から正極として使用するカーボンファイバー２２の一方の断面側に正極集電体１８を押しつけ、他方の断面側にも正極集電体１８を押しつける。正極集電体１８と直角面となる、負極として使用するカーボンファイバー２６の一方の断面側に負極集電体２０を押しつけ、他方の断面側にも負極集電体２０を押しつける。電解液を注入した後、蓋３２をして電池を完成させる。本実施の形態では、織物の直角方向の４面から集電体で押さえた構成としているが、織物の直角方向の２面又は３面から集電体で押さえた電池とすることも可能である。３４は絶縁部材である。なお、図７では、手前側の負極集電体の図示を省略している。他の構成及び作用効果は、実施の第１、第２形態の場合と同様である。

【００３３】図８、図９は、本発明の実施の第５形態によるファイバー電池の一例を示している。本実施の形態は、一例として、実施の第１形態の電池を４個つくり、直列に積層して高電圧な電池としたものである。図８は単セルの一部を拡大したものである。この場合、単セル同士の間に設ける隔壁３６を共通化することで簡単に高電圧化が可能で、なおかつ、面積が大きく厚みの薄い隔壁３６とすることで、電圧低下が極めて少ない電池とすることができる。他の構成及び作用効果は、実施の第１形態の場合と同様である。

【００３４】図１０、図１１は、本発明の実施の第６形態によるファイバー電池の一例を示している。本実施の形態は、一例として、実施の第２形態の電池を４個つくり、直列に積層して高電圧な電池としたものである。図１０は単セルの一部を拡大したものである。他の構成及び作用効果は、実施の第１、第２、第５形態の場合と同様である。

【００３５】図１２は、本発明の実施の第７形態によるファイバー電池の一例を示している。本実施の形態は、一例として、実施の第４形態の電池を１６個つくり、縦横４個×４個を直列に接続して高電圧な電池としたものである。３８は接続板であり、隔壁と同じ役割である。他の構成及び作用効果は、実施の第１、第２、第４、第５、第６形態の場合と同様である。

【００３６】図１３、図１４は、本発明の実施の第８形態によるファイバー電池の一例を示している。本実施の形態は、一例として、樹脂を用いて、基材であるカーボンファイバーに正極活物質としてニッケル／水酸化ニッケル、負極活物質として水素吸蔵合金をつけ、さらにその外側に多孔質樹脂をコートして構成したニッケル－水素電池である。本実施の形態のファイバー電池の製造例について説明する。例えば、内容積１０リットルのヘンシェルミキサーに粒子状黒鉛（アセチレンブラック、ケッチェンブラック）を１５０g入れ、１００-０rpmで約３分間撹拌して粒子状黒鉛を十分に分散する。これに、電池用水酸化ニッケル粉末を１０００g添加し、約３分間１０００rpmで混合する。別途、６０℃に加熱したキシレン２０００gにエチレン酢酸ビニルコーポリマーを３００g添加し溶解させる。６０℃に加熱した前記の粒子状黒鉛と水酸化ニッケル粉の混合物に、加熱キシレンに溶解した樹脂を添加し、６０℃に加熱保持しながらヘンシェルミキサーで撹拌し、分散する。これにカーボンファイバーを浸漬し、引き上げる。そして、真空加熱炉により５０℃で真空乾燥し、キシレンを気化させる。つぎに、ＰＥＳをＤＭＳＯに溶解させた樹脂液に上記のカーボンファイバーを浸漬して引き上げる。これを水に浸漬し、ＤＭＳＯを水で抽出しＰＥＳを固化することで多孔質膜とする。このニッケル／水酸化ニッケルで表面をコートし、さらに外側を多孔質膜でコートしたカーボンファイバーを正極として使用する。

【００３７】また、例えば、内容積１０リットルのヘンシェルミキサーに粒子状黒鉛（アセチレンブラック、ケッチェンブラック）を１５０g入れ、１０００rpmで約３分間撹拌して粒子状黒鉛を十分に分散する。これに、電池用水素吸蔵合金粉末を１０００g添加し、約３分間１０００rpmで混合する。別途、６０℃に加熱したキシレン２０００gにエチレン酢酸ビニルコーポリマーを３００g添加し溶解させる。６０℃に加熱した前記の粒子状黒鉛と水素吸蔵合金の混合物に、加熱キシレンに溶解した樹脂を添加し、６０℃に加熱保持しながらヘンシェルミキサーで撹拌し、分散する。これにカーボンファイバーを浸漬し、引き上げる。そして、真空加熱炉により５０℃で真空乾燥し、キシレンを気化させる。つぎに、ＰＥＳをＤＭＳＯに溶解させた樹脂液に上記のカーボンファイバーを浸漬して引き上げる。これを水に浸漬し、ＤＭＳＯを水で抽出しＰＥＳを固化することで多孔質膜とする。この水素吸蔵合金で表面をコートし、さらに外側を多孔質膜でコートしたカーボンファイバーを負極として使用する。

【００３８】正極活物質を表面にコートしさらに外側を多孔質膜でコートしたカーボンファイバー２２を、断面が露出した一方の端を正極集電体側として位置を揃え、他方の多孔質膜２４で被覆した端が負極集電体側となるように並べる。負極活物質を表面にコートしさらに外側を多孔質膜でコートしたカーボンファイバー２６を、断面が露出した一方の端を負極集電体側として位置を揃え、他方の多孔質膜２４で被覆した端が正極集電体側となるように並べる。正極と負極はランダムに並べてもかまわないが、交互に並べた方がより高性能な電池となる。層状のカーボンファイバーを電池セル１６に装填し、層状のカーボンファイバーに対して直角方向（垂直方向）から正極として使用するカーボンファイバー２２の断面側に正極集電体１８を押しつける。正極集電体１８側が底面となるようにした状態で、電解液を注入した後、反対側である、負極として使用するカーボンファイバー２６の断面側に負極集電体２０を押しつけて電池を完成させる。他の構成及び作用効果は、実施の第１、第２の場合と同様である。本実施の形態の正極、負極を、実施の第３、第４、第６、第７形態の構成に適用することも勿論可能である。

【００３９】図１５、図１６は、本発明の実施の第９形態によるファイバー電池の一例を示している。本実施の形態は、一例として、電気分解による電解析出法を用いて、基材であるニッケルファイバーに正極活物質としてニッケル／水酸化ニッケル、負極活物質として鉄／水酸化鉄をつけて構成したニッケル－鉄電池である。本実施の形態のファイバー電池の製造例について説明する。硝酸ニッケル浴中でニッケルファイバーを陰極、ニッケル板を陽極として電気分解を行い、ニッケルファイバー表面にニッケル／水酸化ニッケルを電解析出させる。このニッケル／水酸化ニッケルで表面をコートしたニッケルファイバーを正極として使用する。また、硝酸鉄浴中でニッケルファイバーを陰極、鉄板を陽極として電気分解を行い、ニッケルファイバー表面に鉄／水酸化鉄を電解析出させる。この鉄／水酸化鉄で表面をコートしたニッケルファイバーを負極として使用する。

【００４０】正極活物質を表面にコートしたニッケルファイバー４０を一列に並べて、その上にセパレータ１２としてテフロン膜を敷く。このとき、正極集電体側となる端は正極のニッケルファイバー４０の断面が露出した状態でセパレータ１２とともに位置を揃えて、負極集電体側となる端ではセパレータ１２の方が長くなるようにする。そして、セパレータ１２の上に負極活物質を表面にコートしたニッケルファイバー４２を一列に並べる。このとき、負極集電体側となる端は負極のニッケルファイバー４２の断面が露出した状態でセパレータ１２とともに位置を揃えて、正極集電体側となる端ではセパレータ１２の方が長くなるようにする。さらにその上にセパレータ１２を敷き、正極と負極をセパレータを挟んで積層していく。層状のカーボンファイバーを電池セル１６に装填し、層状のカーボンファイバーに対して直角方向（垂直方向）から正極のニッケルファイバー４０とセパレータ１２を揃えた面に正極集電体１８を押しつける。正極集電体１８側が底面となるようにした状態で、電解液を注入した後、負極のニッケルファイバー４２とセパレータ１２を揃えた面、すなわち、正極集電体１８と反対側から負極集電体２０を押しつけて電池を完成させる。他の構成及び作用効果は、実施の第１形態の場合と同様である。本実施の形態の正極、負極を、実施の第２～第７形態の構成に適用することも勿論可能である。

【００４１】図１７～図２０は、本発明の実施の第１０形態によるファイバー電池の一例を示している。本実施の形態は、一例として、樹脂を用いて基材であるカーボンファイバーに電池活物質をつけたものを正極として使用し、負極側はプレート状に成形した電池活物質を充填して構成したニッケル－水素電池である。本実施の形態のファイバー電池の製造例について説明する。

（１）負極の製作

例えば、内容積１０リットルのヘンシェルミキサーに粒子状黒鉛（アセチレンブラック、ケッチェンブラック）を１５０g入れ、１０００rpmで約３分間撹拌して粒子状黒鉛を十分に分散する。これに、電池用水素吸蔵合金粉末を２５００g、炭素繊維（商品名：ドナＳ－２４７）を１００g添加し、約３分間１０００rpmで混合する。別途、６０℃に加熱したキシレン１０００gにエチレン酢酸ビニルコーポリマーを１５０g添加し溶解させる。６０℃に加熱した前記の水素吸蔵合金粉と導電性フィラーの混合物に、加熱キシレンに溶解した樹脂を添加し、６０℃に加熱保持しながらヘンシェルミキサーで撹拌する。次いで、撹拌しながらヘンシェルミキサーを冷却し、混練物を冷却粉砕して粉末状とする。この粉末をハイスピードミキサーに入れ、アジテータで粉体全体を撹拌しつつ、チョッパーで造粒粒子の粒径を調節する。ハイスピードミキサーは２リットル容量の物、アジテータの回転数は６００rpm、チョッパーの回転数は１５００rpmで、この条件で撹拌しつつ、粉体の温度を常温から５０℃に昇温する。造粒粒子が生成した後、冷却しつつ撹拌を停止する。粒子はキシレンを含んでいるため、この粒子を減圧乾燥機に入れ、５０℃に加熱してキシレンを除去する。この粒子を冷却した後、２．８８mm目の篩と１mm目の篩でふるい、１～２．８８mmの一次成形粒子とする。一次成形粒子９０gを１００mm□の型枠に充填し、型枠ごと１００℃に加熱して一次成形粒子に含有される樹脂（エチレン酢酸ビニルコーポリマー）を軟化させる。次いで、型枠中で０．１MPaの圧力をかけた状態で、温度を下げ、樹脂を硬化させる。これを型枠から取り出し、得られたプレート状活物質４４を負極として使用する（図１７）。

【００４２】（２）正極の製作

例えば、内容積１０リットルのヘンシェルミキサーに粒子状黒鉛（アセチレンブラック、ケッチェンブラック）を１５０g入れ、１０００rpmで約３分間撹拌して粒子状黒鉛を十分に分散する。これに、電池用水酸化ニッケル粉末を１０００g添加し、約３分間１０００rpmで混合する。別途、６０℃に加熱したキシレン２０００gにエチレン酢酸ビニルコーポリマーを３００g添加し溶解させる。６０℃に加熱した前記の粒子状黒鉛と水酸化ニッケル粉の混合物に、加熱キシレンに溶解した樹脂を添加し、６０℃に加熱保持しながらヘンシェルミキサーで撹拌し、分散する。これにカーボンファイバーを浸漬し、引き上げる。そして、真空加熱炉により５０℃で真空乾燥し、キシレンを気化させる。正極活物質を表面にコートしたカーボンファイバー４６において、活物質で覆われていないファイバー一部分を一つのニッケルプレートで固定し、正極外部端子４８とする。得られた外部端子付きファイバー状活物質５０を正極として使用する（図１８）。

【００４３】（３）組立

図１９に示すように、負極であるプレート状活物質４４を横にして置いた上にセパレータ１２を敷く。その上に正極である外部端子付きファイバー状活物質５０を置き、正極外部端子４８を外部にはみ出させる。さらに上から絶縁シート５２（セパレータで可）をかぶせる。この状態のものを、図２０に示すように、負極であるプレート状活物質４４が、負極集電体であり電池セルも兼ねる負極外部端子５４と接触するように、電池セル１６に充填する。電解液を入れた後、蓋３２をして電池を完成させる。なお、本実施の形態において、正極、負極は任意の組み合わせとすることが可能である。また、粒子状活物質を充填した電池セルに、電池活物質で表面をコートしさらにその外側を多孔質膜で被覆したカーボンファイバー等を挿入して電池を構成することも可能である。

【００４４】

【発明の効果】本発明は上記のように構成されているので、つぎのような効果を奏する。

（１）　電池活物質において電子伝導性が極めて小さいものや反応するために移動しなければならない物質が巨大なものは、移動距離を極力短くすることで高出力が可能になるので、電子等の移動通路として繊維状の電子伝導性のある物質の表面に薄い電池活物質層をつけたものを、束ねたり又は織物として積層するなどして電池を構成することにより、従来の電池と比較して充電速度、放電速度ともに飛躍的に向上した高出力が可能な電池を得ることができる。

（２）　電子伝導性のある繊維状物質表面に電池活物質をつけさらにその外側に電子伝導性がなくイオン伝導性のある多孔質な物質をコーティングしたものを、交互にあるいはランダムに並べるだけ、あるいは織物状にして、これらを積層することで電池として機能させることができる。

（３）　電池活物質を表面にコートした電子伝導性のある繊維状物質を並べたり織物として積層したものを集電体で押さえ込むだけでよいので、従来の電池のような溶接は不要であり、容易にリサイクルできる。

（４）　単セルを積層していき高電圧とする場合、単セル同士の間に設ける隔壁を共通化することで簡単に高電圧化が可能で、なおかつ、面積が大きく厚みの薄い隔壁とすることで、電圧低下が極めて少ない電池とすることができる。

【図面の簡単な説明】

【図１】本発明の実施の第１形態によるファイバー電池の一例を示す繊維の長手方向から見た模式図である。

【図２】本発明の実施の第１形態によるファイバー電池の一例を示す繊維の横断面方向から見た模式図である。

【図３】本発明の実施の第２形態によるファイバー電池の一例を示す繊維の長手方向から見た模式図である。

【図４】本発明の実施の第２形態によるファイバー電池の一例を示す繊維の横断面方向から見た模式図である。

【図５】本発明の実施の第３形態における圧密状態の基本ユニットの一例を示す繊維の横断面方向から見た模式図である。

【図６】本発明の実施の第３形態によるファイバー電池の一例を示す繊維の長手方向から見た模式図である。

【図７】本発明の実施の第４形態によるファイバー電池の一例を示す模式図である。

【図８】本発明の実施の第５形態における単セルの一部を拡大したもので繊維の長手方向から見た模式図である。

【図９】本発明の実施の第５形態によるファイバー電池の一例を示す模式図である。

【図１０】本発明の実施の第６形態における単セルの一部を拡大したもので繊維の長手方向から見た模式図である。

【図１１】本発明の実施の第６形態によるファイバー電池の一例を示す模式図である。

【図１２】本発明の実施の第７形態によるファイバー電池の一例を示す模式図である。

【図１３】本発明の実施の第８形態によるファイバー電池の一例を示す繊維の長手方向から見た模式図である。

【図１４】本発明の実施の第８形態によるファイバー電池の一例を示す繊維の横断面方向から見た模式図である。

【図１５】本発明の実施の第９形態によるファイバー電池の一例を示す繊維の長手方向から見た模式図である。

【図１６】本発明の実施の第９形態によるファイバー電池の一例を示す繊維の横断面方向から見た模式図である。

【図１７】本発明の実施の第１０形態におけるプレート状活物質の一例を示す模式図である。

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【図１８】本発明の実施の第１０形態における外部端子付きファイバー状活物質の一例を示す模式図である。

【図１９】本発明の実施の第１０形態における組立工程を示す模式図である。

【図２０】本発明の実施の第１０形態によるファイバー電池の一例を示す繊維の長手方向から見た模式図である。

【符号の説明】

１０、４６　正極活物質を表面にコートしたカーボンファイバー

１２　セパレータ

１４　負極活物質を表面にコートしたカーボンファイバー

１６　電池セル

１８　正極集電体

２０　負極集電体

２２　正極活物質を表面にコートしさらに外側を多孔質膜でコートしたカーボンファイバー

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２４　多孔質膜

２６　負極活物質を表面にコートしさらに外側を多孔質膜でコートしたカーボンファイバー

２８　ポリプロピレンバンド

３０　織物

３２　蓋

３４　絶縁部材

３６　隔壁

３８　接続板

４０　正極活物質を表面にコートしたニッケルファイバー

４２　負極活物質を表面にコートしたニッケルファイバー

４４　プレート状活物質

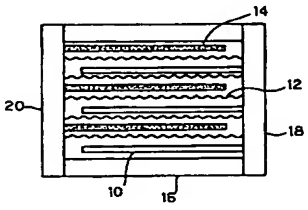
４８　正極外部端子

５０　外部端子付きファイバー状活物質

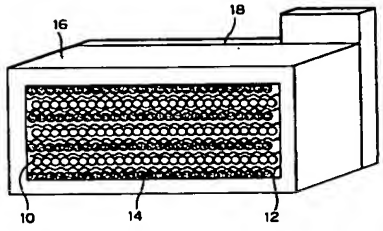
５２　絶縁シート

５４　負極外部端子

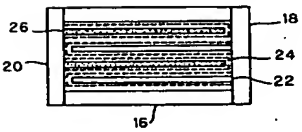
【図１】



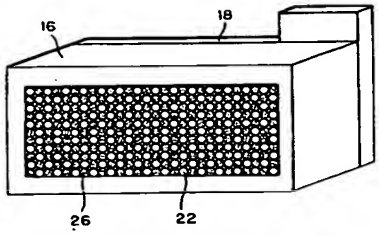
【図２】



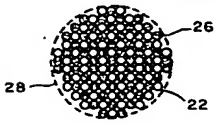
【図３】



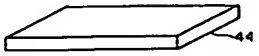
【図４】



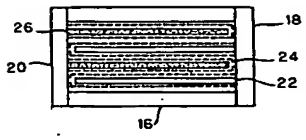
【図５】



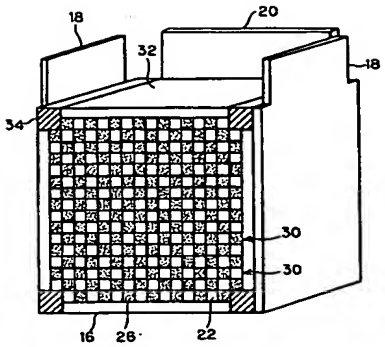
【図１７】



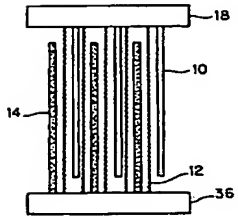
【図６】



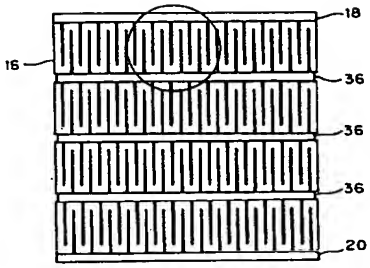
【図７】



【図８】



【図９】



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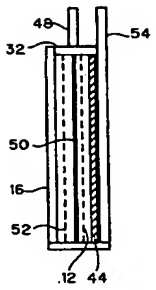

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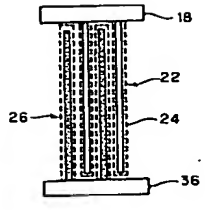

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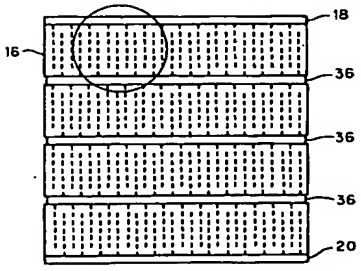

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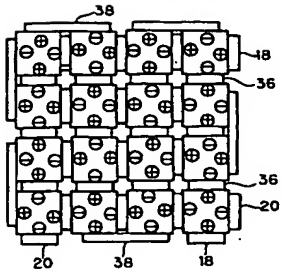

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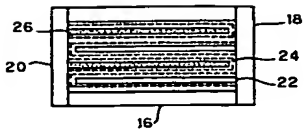

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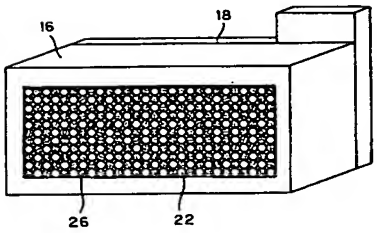

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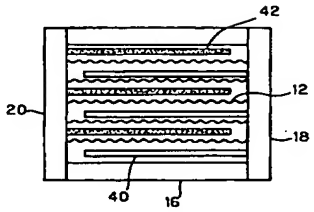

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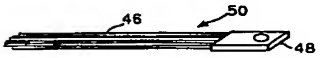

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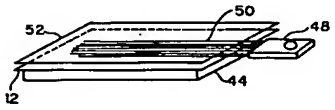

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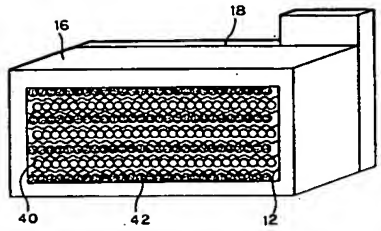

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